A·S·L·E

Lubrication ENGINEERING

DEDICATION

The American Society of Lubrication Engineers dedicates its Journal to increasing the fund of knowledge in the field of lubrication; to making available the discoveries of research to applied lubrication; to giving recognition to the importance of lubrication and the Lubrication Engineer in industry; to fostering research, data, techniques and news as an impartial organ of lubrication.

PUBLISHED QUARTERLY

JUNE

1945

VOL. 1 ★ NO .1

JOURNAL OF THE AMERICAN SOCIETY OF LUBRICATION ENGINEERS

Lubrication Engineering has purposely refused all advertising in this, its first issue, in order to devote its entire space to technical papers and news of the Society and the industry.

NUMBER 1
VOLUME 1
JUNE
1945

Lubrication ENGINEERING

Official Publication
OF THE
AMERICAN SOCIETY
OF
LUBRICATION ENGINEERS

Room 749 Field Bldg.,
135 S. LaSalle St., Chicago 3, Ill.

Published at 22 E. 12th Street
Cincinnati 10, Ohio

BURGESS H. JENNINGS
Editor
Northwestern Technological Institute
Evanston, Ill.

OFFICERS OF THE A.S.L.E.

C. E. PRITCHARD
Cleveland, Ohio
President

J. C. PEEBLES
Chicago, Ill.
Vice-President

B. H. JENNINGS
Evanston, Ill.
Secretary and Treasurer

D. N. EVANS
East Chicago, Ind.
Director

D. E. WHITEHEAD
Pittsburgh, Pa.
Director

CONTENTS

Editorials

President's Message 2
C. E. Pritchard

Aims and Purposes of "Lubrication Engineering" 3
E. M. Kipp

Feature Articles

Lubrication from Management's Viewpoint 4
Warren G. Bailey

A Survey of Evaluation Methods for Crankcase Oils for Internal Combustion Engines 7
N. C. Penfold and E. C. Petry

A Method of Testing Cutting Oils 12
H. L. Moir, J. S. Yule, D. J. Wangelin and R. J. Moyer

The Scope of Lubrication Engineering in Industry 21
W. T. Everitt

News of the Sections

Pittsburgh Section 30
Milwaukee Section 30
Cleveland-Youngstown Section 30
Chicago Section 31

A Brief History of the American Society of Lubrication Engineers
B. H. Jennings

Biographical Sketches of Society Officers 28
C. E. Pritchard 28
J. C. Peebles 28
B. H. Jennings 29
D. N. Evans 29
D. E. Whitehead 29

A.S.L.E. Committees and Membership Requirements ..... Inside Back Cover

Price: Subscription price, $3.00 per year. Single copies, 75c each, postpaid.

Copyright: Copyright 1945 by the American Society of Lubrication Engineers.

The A. S. L. E. will not be responsible for statements or opinions advanced in its meetings or printed in its publications.

Address correspondence regarding contents, manuscripts, etc., to the editor at Northwestern Technological Institute, Evanston, Ill.

Inquiries regarding advertising space and rates should be addressed to Alfred Chadburn, Advertising Manager, 1008 Times-Star Building, Cincinnati 2, Ohio. Rates on request.

President's Message

The problem of satisfying the many and varied requirements of industry to ensure an unfaltering production of the needed commodities for our armed forces has placed a very heavy burden of responsibility upon the Lubrication Engineer as it has on the other members that go to make up a production team of industry.

It is gratifying to know that the American Society of Lubrication Engineers, through the medium of our technical meetings, standardization programs, research and publications should contribute materially both to the present War Effort and the post-war problems of tomorrow.

The importance of lubrication as a subject is progressing with ever increasing interest on the part of alert management who, during the trying times of today due to constantly changing production schedules and the extremely rapid change-over of operating personnel, has realized the need for a better and more unified approach to controlled lubrication if production schedules are to be met.

Practically every branch of industry employs lubrication in some form or other. Our Society, with such a widespread coverage, provides a common ground for the technicians and operators to meet, form contacts and exchange ideas, thereby expanding their personal fund of knowledge and, in turn, benefiting the companies they represent.

Active participation in the Society activities by the members will further the progress of lubrication to such an extent that, undoubtedly, it will be elevated to its rightful position of importance in all phases of industry in a comparatively short space of time.

Also, and of equal importance, is the necessity of promoting the interests of the younger members still in the various colleges and universities who are destined to carry the burden of future progress in industry in the years to come. We strongly urge their active participation in the Society's activities to give and thereby receive the mutual benefits that such an association can offer.

C. E. Pritchard

Aims and Purposes of "Lubrication Engineering"

As the official publication of the American Society of Lubrication Engineers, *Lubrication Engineering* is confronted with a potentially important yet sobering opportunity for service to the welfare of our country.

The present world conflict, now happily in its concluding phases, has vividly demonstrated as never before the vital role played by lubrication in all phases of this modern age of mechanical wonders. It has been truly stated that "oil" has been and is the lifeblood of the mechanical phases of our war effort on the battlefield, in the supply lines, and in the massive and awe-inspiring demonstration of our country's industrial might and productivity. Every phase of our highly mechanized civilization is directly and completely dependent upon efficient lubrication for satisfactory performance and value, from the smallest complex precision time-keeping mechanism to massive mechanical giants such as locomotives weighing hundreds of tons.

The broad field of lubrication has been, in the past, all too frequently relegated to a position of incidental importance, and for that reason has largely remained, even today, an art rather than a science. There is, however, a rapidly growing realization and appreciation of the true role of lubrication in relation to operating efficiencies, maintenance costs, productivity, quality of product, and the achievement of otherwise unattainable goals through better understanding and appreciation of lubrication in all of its varied phases. The field of lubrication is thus crossing the threshold of a new era of intense and important scientific development which is rich in the promise of better things to come.

The availability of a medium wherein new knowledge, ideas, experiences, and suggestions can be assembled, correlated, weighed, and suitably presented will play a key role in the advancement of this infant science.

The A. S. L. E. has as one of its leading goals the fulfillment of this need through its official publication, *Lubrication Engineering*. In attempting to achieve this goal, it is the Society's intention to correlate and cover in a well-balanced manner every aspect of lubrication. Thus, *Lubrication Engineering* will concern itself with theoretical studies of a purely long range fundamental nature; with studies and experiences of a predominantly practical nature; with the identification and description of problems to be solved; with matters pertaining to the relationships extant between lubrication and other allied or supporting sciences; and with any phases of endeavor allied or interdependent with lubrication. It is also the hope and intention of the Society through *Lubrication Engineering* to serve its membership and friends by reviewing, summarizing, and assaying the large amount of published knowledge, facts, and data available but existing largely as a mass of uncorrelated and undigested data.

The Society is therefore taking this means to invite the interest, cooperation, and support of its members, friends, and all others who are interested in these matters, and to offer its Journal as a medium for publication of all problems of interest and import in this field.

In so doing, the Society feels that it can be of greatest service by limiting publications to papers, comments, and communications of outstanding merit and interest; and to papers reflecting above average qualities of initiative, imagination, and boldness of attack, be the subjects ones of theoretical or practical application.

The Society also wishes to take this opportunity to invite suggestions and criticisms with reference to ways and means whereby *Lubrication Engineering* can best serve the interests and needs of those who, whether by profession or avocation, are concerned with the complex and challenging unknowns of the science of lubrication.

E. M. KIPP, Chairman,
Program, Planning and
Publications Committee.

Lubrication From Management's Viewpoint*

By WARREN G. BAILEY

Partner—McKinsey, Kearney and Company, Chicago

It is a pleasure indeed to join with you in this, the first, or one of the first, meetings of the Chicago Section of the American Society of Lubrication Engineers. Even to be able to use the term "Lubrication Engineer" marks progress. This must indicate advance through the years in experience, in research and in service.

In effect you have asked me to talk about three things: Management, the viewpoint from which Management sees lubrication, and lubrication itself as seen by Management.

Management

The principal objective of the General Management in any industrial business is to transform the assets of the business into products which may be sold profitably. This process of transformation, or change of assets into product, has many phases. As a whole, we call it manufacturing. The change is applicable to assets of every type.

Cash, as an asset, is perhaps the one, to which management has, over the years, given most of its attention. From its experience, Management has devised techniques to aid in the protection of cash, the custody of cash, the receiving of cash, the handling of cash and the disbursing of cash. It is a subject to which Management has applied its experience, its time and its effort, until today we have quite a body of knowledge and facts and of techniques that are applicable — even though from time to time you may read of instances in the paper which make you think that this is a neglected subject. We are far advanced in these matters.

Accounts receivable represent another class of assets to which, over the years, Management has applied intensively its effort in the development of techniques to protect its assets, to make sure that sales are not made to customers who will not be a good risk to the business, to assure collection of accounts, to measure the activity of the accounts and to determine the manner in which loss can be minimized. There is a vast body of knowledge and well developed methods which are being employed to preserve the asset, and to aid in assuring that it maintains its value.

Inventories of materials, of parts and of product represent another group of assets to which Management, generally speaking, has given a vast amount of time, attention and effort in the development of practices and controls to govern the custody, the storage, the movement and the use of the assets to obtain from them the greatest value with the minimum of loss. Inventory control, materials planning, storage records, bills of material and perpetual inventories are all terms which indicate in a limited fashion, the vast development which has been made by Management in the conservation of this group of assets.

Fixed assets is another group to which Management at various times has given considerable attention. I think we can say without contradiction, that notwithstanding all the progress which has been made, this group of assets still presents more opportunity for advance through research than any of the others. Accountants and engineers over the years have given attention to the subject, and there are evidences of considerable progress, but there is apparently still plenty of opportunity for Management to know more about this group of assets and to develope more effectively, the methods and the techniques of protecting and conserving the assets, of assuring their proper use, and of protecting the rate of change of the asset into product. While the other assets follow through from asset to product quickly in any business, fixed assets pass through the transformation very gradually. It is therefore necessary for special techniques to be developed to govern the accounting, costing, use, and the preservation of the asset itself.

It is of interest to note that Management has developed a number of techniques, applicable to the business more or less generally, to effect its principal objective of directing and supervising the process of change which takes place in the transformation of its assets to saleable products. These techniques might be listed generally as follows:

1. *Organization,* which is the process of establishing positions in business with responsibility and authority for the performance of certain definite duties, and which contemplates the delegation of authority and responsibility to supervisors and personnel at varying levels, from the highest to the lowest, in a company organization structure. Each position, under these circumstances, has special duties to perform, and in this manner, the management carries out the process of change.

2. *Instructions,* which involve the method of telling personnel how to perform duties, and of setting up standard practices for getting work done.

3. *Accounts,* which throughout the years have been developed as the method of recording the expense of getting business done, as well as indicating the value of assets and the extent of debts incurred.

4. *Costing,* which is a phase of accounting that has been developed more recently to cover, primarily, manufacturing operations of the business and indicate the cost of the products produced.

5. *Statistics,* which are used in indicating the status of manufacturer, the volume of work done and the extent of performance or progress.

6. *Budgets,* which establish the program for the future, the volume and value of products to be

* *Presented before the Feb. 9, 1945 meeting of the Chicago Section of the American Society of Lubrication Engineers.*

turned out, and the revenues, expenses and profits anticipated.

7. *Reports,* which are required from various parts of the business to indicate achievements, costs, expenses or conditions, of which the Management must be advised to operate satisfactorily.

8. *Research,* which constitutes special attention to special subjects relating to processes, methods, products, machines or tools for the purpose of making improvements in them.

With this array of techniques, Management approaches the entire subject of operation, the process of changing its assets to products and their delivery to customers. In it all, you must keep in mind that Management has its definite objective—Profit—and the obtaining of that profit through saleable products made by the transformation of its assets.

This attainment of profit naturally places emphasis on the elements that most affect profit. Profit is only that portion of the selling price which is not included in cost. Cost is by far the larger part of the sales value of any item. Because of this, Management sees the whole process, insofar as you gentlemen are interested, from the standpoint of the cost of the product, or the cost of doing business. We have already indicated that manufacturing is a business of change, of transforming assets, of movement, and cost is applicable in this case to the "going business."

The Viewpoint of Management

Let's take this viewpoint of Management then, and look at the process of change from the standpoint of cost. For our present purpose we can restrict our comments to manufacturing cost.

The cost of manufacturing operations includes manufacturing expenses, manufacturing labor and materials. For our purposes, we will say also the cost of fixed assets, particularly machinery and equipment, though in our accounting processes, this cost is finally found in the expense or burden cost of manufacturing.

It is interesting to note that materials and labor are taken into the direct cost of operation and the direct cost of the product, and that many expenses similarly are taken directly into the cost of operation, though they usually are applied to the cost of product on an indirect basis.

Fixed assets, including machinery and equipment, however, are not taken directly into cost. They are used, transformed or changed into product, on a very gradual basis. They create a special problem for the accountant and for the engineer. To get the use of machines into the cost of product, the accountant has had to devise special methods of accounting. He has had to ask the engineer to aid him in setting up the data required. Plant accounting is a fairly new technique in the accounting field. It is often done inadequately, often intermittently, and seldom on a complete and satisfactory basis.

The author, describing management's point of view, states that Lubrication Engineers have a two-fold job to do. They must develop, through investigation and reasoning, all the facts pertaining to conservation and efficient operation of production equipment. They must also present the facts thus determined to management in such a manner that management will adopt measures and techniques required to attain the low operation costs attainable.

To get the cost of machinery into the cost of product, the accountant must ask the engineer to establish the "life" of the machine or the equipment which makes up the fixed assets of the company involved. If the engineer determines that the "life" of the machine on a normal basis would be ten years, the accountant takes the total cost, which includes the original purchase price of the machine, the cost of installation and of getting it into operation, divides it by ten, and uses the resulting figures as the annual machine expense to be absorbed in cost. This decrease in the asset value, or depletion of the asset, is commonly called depreciation. For ordinary accounting, this figure would be divided by twelve to determine the monthly charge to be made to factory burden or factory expense, and thereafter applied by cost techniques to the cost of the product.

The result arrived at through this process of determining the amount to be absorbed into cost, results in setting a standard figure which is supposed to measure the resulting decrease in the value of the machine, or the use of the machine, or the portion of the machine that is used up in production—the part of the machine which is actually applied to the products produced.

Now if this estimated life of the machine is exactly accurate, and if the machine performs perfectly as contemplated, the cost is exactly absorbed into the cost of product in the estimated life of the machine. However, if we can find ways of prolonging the life of the machine, of making it operate more smoothly so that it will have a greater output for this estimated life, or if we can adopt measures which will result in fewer shutdowns or breakdowns, less defectives from machine operation or more satisfactory output, we have a chance immediately to save, as against the standards adopted and taken into our costs. The cost of maintenance and the cost of repairs are vital items in any business having a large portion of fixed assets which are used in its manufacturing processes. With less maintenance, there is lower direct cost. With less repairs, there is lower direct cost. If the measures adopted improve the operation of the machines and equipment, they effect direct savings. Then we have a number of sources from which to derive profit in the operation of the business which will aid greatly in building working capital, improve the financial condition of the business generally, and obtain an indirect benefit of customer good will and product performance.

Many things can be done by the management to aid in obtaining full production from its fixed assets. The whole area of production control, production planning, production scheduling, dispatching, process engineering, tool design, machine routing, standard time and related techniques, which management has developed in recent years, in many instances almost in profusion, have been directed toward achieving greater efficiency in machines and men.

One field, which in many cases, has not been given the attention that it should have, is that of the direct measures which can be applied for the preservation and maintenance of the equipment itself to attain many of the results Management has otherwise sought. I refer to the whole subject of Lubrication as you men have it in mind.

Lubrication

It would be a simple thing here to quote some technical definition of the term "lubricant," but in his

less professional way, Webster has said that: "It is a substance which is applied to moving parts in an effort to reduce friction."

This brings many thoughts to me. I can remember in my first factory job how the oiler and the laborer with his grease can, would go from spot to spot, dropping a little oil here and there on the overhead shafting. Or, going from machine to machine, take off a grease cup, fill it and put it back again. There was little or no thought of the real importance of the task, or the elements of the problem of lubrication.

Later there came some advance with the coming of the maintenance man and the maintenance department. Still later, came the more modern maintenance department with its specialists for certain types of maintenance and repairs. Only recently has this developed to a point where we talk now of the plant engineer. Even he is scarce, so far as many of even the fairly large companies are concerned.

It seems to me that there are several things in which the management is interested when the subject of lubrication is considered, especially when we analyze the subject from the standpoint of cost. After all, it is primarily cost which interests Management.

There is the cost of the lubricant, which is a direct cost in its manufacturing accounts. From the standpoint of the direct cost of the lubricant alone, the lower the cost per pound or per gallon, the better Management is satisfied. But a wise Management is not satisfied with giving its attention to direct cost only. It must also be interested in the frequency with which the lubricant and the cost of the lubrication process has on the asset and on the product, and particularly upon the cost of the product manufactured. It therefore must give consideration to the effect of the lubricant and the frequency of its application on the life of the machine, excessive maintenance costs, the extent of repair costs, and the frequency of shutdowns and breakdowns.

Then there is the question of the performance of the machine. It will operate more smoothly if there is less stress and strain on the machine itself. If there is less wear the machine may have a very much longer life than contemplated when the depreciation rates were set. On this, the management will make a profit by the saving of depreciation expense, perhaps for one or two, or ten years beyond the life expectancy.

Then there is the question of the number of pieces or parts or products—or even of operations—which the machine will deliver. If there are less shutdowns, less breakdowns, smoother operation, the volume of units may be vastly increased for the same amount of wear, depletion and depreciation of the machine.

The effect of the lubricant on the performance of personnel is also important. Dermatitis and other forms of affliction caused by some lubricants hinder production. Accidents resulting from poor lubrication result in loss of time and extra cost and expense to the company. To the extent that lubricants can avoid these results, cost is reduced and performance is increased. All of these factors must be considered in judging the cost of the lubricant.

These are some of the ways in which management views the subject of lubrication, and some of the points to which it must give greater and greater attention.

Perhaps we should stop for a moment and give just a little attention to the cost of materials. One of the excessive costs in any highly machined business, is that of materials. Standard allowances are usually made for loss because of rejections and defective performance by machines and personnel, but in recent years these normal ratios have been far below the actual loss. Some of the reasons for these excessive losses may be attributed to poor engineering, bad tooling and poor timing and planning of work. Some of it however, is the result of poor performance on the part of machines, because of poor lubrication, excessive breakdown and wear.

The Lubricating Engineer

The Management is interested in the cost of operation, and particularly in the cost of operation as it is affected by the cost of machines in the manufacturing process. All the subjects which have been mentioned have come to the attention of Management; many companies have spent a great deal of money in an effort to solve most of the questions which may arise, and many have taken steps which would keep costs within reason and the performance of equipment and of personnel satisfactory. A great many of the problems require further special attention.

To a great extent, industry has depended upon companies selling lubricants to tell them what their lubricants will do, and to assist them in their problems of lubrication, without employing men themselves, who are qualified either to properly maintain their machines and equipment, or to analyze the problems which are so vital in the conservation of fixed assets, or in controlling their depletion in manufacturing operations.

Through the years of experience, and the process of development from the old situation with the oiler and the laborer, to the maintenance man and the maintenance department, to the plant engineer, there now emerges the "Lubrication Engineer," who, in this picture, it seems to me has special and important responsibilities. He has a two-fold job;

1. Research and analysis, as required to develop fully all the facts in the problem of the use of machinery and equipment, and its performance in such a manner as to preserve the asset, slow down its depletion, and improve its operation.

2. The presentation of the facts of the problem, and the conclusions with reference to the solution of the problem, to Management in such a manner that Management will listen, and will adopt the measures and the techniques required to arrive at the low costs necessary for profitable plant operation. You have a selling job, and only as you can operate more or less professionally, impartially and scientifically, can you gain the recognition that you deserve and get the results Management must have.

Perhaps in this connection I should urge that the profession, as I presume we can now call it—now that you have organized the American Society of Lubrication Engineers, must operate without basing its conclusions upon any one product or any one supplier—rather upon the results to be obtained and the maximum returns which will accrue, because the lubricant you recommend must actually get results. It will not pay for any lubrication engineer to join in the practice of reciprocity for immediate sales benefits. The results of the analysis of problems must be based upon the facts and direct findings, and not upon expediency.

Gentlemen, I fear that this discussion has been somewhat complicated and dull, but I have tried to expound somewhat upon the theme presented, particularly to indicate how Management thinks, the viewpoint it takes, how it must look upon this whole subject of lubrication, and how it must judge your effort.

A Survey of Evaluation Methods For Crankcase Oils For Internal-Combustion Engines

By N. C. PENFOLD,* E. C. PETRY*

The evaluation of lubricating oils for internal-combustion engines must necessarily embrace the special problems encountered with this type of mechanism. Not only do engine design, materials of construction and service influence the performance of a lubricant, but also the climatic conditions encountered at the place of operation. Basically, as most operators know, oil is classified according to the climatic conditions encountered in service. In addition to this is another classification, namely that applying to lubricating oils designed for light, medium and heavy duty service. These factors, governing the use of lubricants in engines, are encountered in various combinations, making the problem of establishing tests for initially evaluating oils on the basis of viscosity grade and duty for any given service quite complicated.

Normally, the expression "duty" is associated with the degree of loading or stressing a material is subjected to. With oil, duty not only defines the load carrying characteristics but also its resistance to oxidation, emulsification, polymerization, detergency, corrosiveness and so on. For example, an engine used for domestic milk route service, although lightly loading an oil in terms of bearing and cylinder wall pressures, severely "loads" the oil in terms of emulsification, foaming, corrosiveness and "cold" sludge, by virtue of continual intermittent operation at low water-jacket temperatures. Another example of heavy "duty" on a lubricating oil in an engine operated at a fraction of its rated output could be severe oxidation, polymerization and their accompanying evils from faulty design causing local high temperature areas which deteriorate the lubricating oil excessively on contact. Thus, in establishing or selecting an evaluation method, "duty" must be adequately defined.

It is clearly recognized today that the factors influencing the successful lubrication of an engine are engine design, materials, fuel, lubricant, type of service and maintenance. The modern engine must be designed with careful consideration of the lubrication system, and maintenance must be intelligently administered. These factors are superimposed upon our basic conception of lubricant evaluation and must also be considered in any proposed evaluation method.

This paper is concerned with the evaluation of crankcase oils for automotive types of internal-combustion engines. World War II has emphasized the need for so-called "heavy-duty" or special service oils approaching an "all-purpose" status, which would go far in reducing the problems encountered due to the variables of engine design and service. To our knowledge no oil is available which has a true "all-purpose" character. Also, no oil should be expected to compensate for poor design, severe service or neglect, but these oils may help to prolong engine life should these conditions prevail. Our Armed Forces recognize the value of these oils and have adopted comprehensive methods for their inspection and evaluation and specify their use.

Evaluating methods have steadily increased in number and scope and at the present time represent a comprehensive analytical accomplishment. The oil and engine industry has long studied the problem. We are exceptionally conscious of an increased activity brought on by this mechanized war. In general, oil analysis methods may be classified as to purpose into identification and inspection, research and evaluation procedures. Many procedures overlap and may apply to the three purposes indicated. In all cases the data resulting from an application of the methods must be interpreted properly before an evaluation may be made. Thus, in the final analysis, the evaluation will indicate the probable service performance only if the method is well chosen and is anticipated to correlate with field service. In this respect, the growth of engine testing of lube oils indicates that at the present time extensive engine tests are required for their evaluation in terms of probable field performance.

Identification and inspection methods are well known to those long associated with petroleum products. They deal with specific inherent properties of an oil and do not necessarily predict all-around service performance. They include:

Gravity
Viscosity
Flash Point
Fire Point
Pour Point
Conradson Carbon
Ash
Neutralization Number
Ultimate Analysis

The value of these physical tests is limited and should be used with great care in evaluating oils. Modern oil refinery methods readily mask the identity of the crude source. Oils having different origins and having different engine performance characteristics may appear to be very similar when inspected by these methods.

Note—This paper was presented at a meeting of the Chicago section of the A.S.L.E., February 9, 1945.

* *Armour Research Foundation, Engine Research Laboratory.*

Table I. Tabulation of Bench Oxidation Tests

1. Sligh.
2. Indiana Oxidation.
3. Modified Indiana Oxidation (Indiana Life). *Refiner and Natural Gas Manufacturer*—Feb. 1941, page 65. "Laboratory Oxidation Tests For Lubricants." Dr. F. Jostes and Dr. A. Hann.
4. Modified Indiana Oxidation (Indiana Stirring Oxidation). *Industrial and Engineering Chemistry (Anal.)*—May 15, 1941, page 317. "Indiana Stirring Oxidation Test For Lubricating Oils." G. G. Lamb, C. M. Loane, J. W. Gaynor—S.O.C. of Indiana.
5. British Air Ministry.
6. British Michie.
7. U. S. Bureau of Mines Oxidation Stability.
8. Italian Sludge.
9. Socony Oxidation Susceptibility.
10. Vacuum Areo.
11. German Tar.
12. G. E. Life Bath.
13. G. E. Bomb.
14. Shell Corrosion and Stability (see also Corr.). *National Petroleum News*—Sept. 17, 1941, page R294. "A Laboratory Machine For Investigating Corrosion." S. K. Talley, R. G. Larsen, W. A. Webb—Shell Development Company.
15. Shell Glass Motor.
16. Shell Oxygen Absorption. *Industrial and Engineering Chemistry*—Feb. 1942, page 183 and May 1943, page 581. "Oxidation Characteristics of Pure Hydrocarbons" and "Catalysis in the Oxidation of Lubricating Oil." R. G. Larsen, F. A. Armfield—Shell Development Company. *Industrial and Engineering Chemistry*—Aug. 1942, page 927. "Oxidation Characteristics of Lubricating Oils." G. H. van Fuchs, H. Diamond—Shell Oil Company, Inc.
17. Eastman Kodak Oxidation and Corrosion. *National Petroleum News*—June 2, 1943, page R-279. "Oxidation-Corrosion of Lubricating Oils." C. L. Pope, D. A. Hall—Eastman Kodak Company.
18. Sohio Aluminum Block.
19. Standard of California Peroxide Formation.
20. Penn State College Oxidation Stability. *Industrial and Engineering Chemistry*—April 1941, page 516. "Oxidation of Lubricating Oils, Factors Controlling Stability." M. R. Fenske, C. E. Stevenson—Penn State College.
21. Penn State College Oxygen Absorption. *Industrial and Engineering Chemistry (Anal.)*—Jan. 15, 1944, page 51. "Oxidation of Lubricating Oils." M. R. Fenske, C. E. Stevenson—Penn State College.
22. Underwood Oxidation (see also Corr.). *SAE Journal (Transactions)*—May 1942, page 196. "Changes Occurring in Oils and Engines From Use." F. A. Swess, W. A. Jones, H. C. Baldwin, B. H. Lincoln—Continental Oil Co.
23. Lauson Engine (see also Deterg. & Corr.).
24. Hot Bar or Plate (also Delft Baking Test). *Institute of Petroleum J.*—Dec. 1939, page 771. "Some Remarks Regarding the Testing of Engine Lubricants." C. A. Bowman—"Delft" Laboratory.
25. Fairlie Oxidation.
26. Army Oxidation.
27. Davis and Blackwood Test.
28. Gulf Oxidation (H. G. Smith).
29. Funk Sludge Test.
30. Bureau of Standard's Aluminum Block. *SAE Transactions*—Oct. 1937, page 483. "Engine and Laboratory Tests of Stability of Aviation Oils." O. C. Bridgeman, E. W. Aldrich—Bureau of Standards.
31. Wright Aero Oxidation. *SAE Journal*—Feb. 1937, page 48. "Selection of Oils For High-Output Aircraft Engines." A. L. Beall—Wright Aeronautical Corporation.
32. Sohio Steel Sleeve and Copper Strip. *Industrial and Engineering Chemistry*—Aug. 1943, page 883. "Deterioration of Lubricating Oils." J. J. Jacobs, D. F. Othmer—Polytechnic Institute, New York.

The second classification of tests could be considered as including those tests which are valuable research tools. These tests are also specific and are often used for identification. However, their most important application is in the more fundamental study of petroleum. These include:

Density
Surface tension
Viscosity index
Index of refraction
Aniline point
Infra-red spectrum
Specific optical rotation
Oxygen absorption rate
Preoxide formation rate
X-ray diffraction pattern
Electron diffraction pattern

Again, these specific tests may or may not be useful in evaluating a lubricant for engine performance, depending upon the extent of the known performance background of the oil in question.

The first classification applying to oil inspection methods is too well-known to discuss further here. A discussion of the second classification is beyond the scope of this paper. The third classification which follows is one confronting the consumer directly. He is interested in tests which reproduce most nearly his operating conditions. It is with this emphasis that the following category of oil tests is described. It should be borne in mind, however, that these test methods do not necessarily apply to the evaluation of finished oils only, as they are regularly applied to research and development in connection with new oils. Their value lies in an approximation of conditions existing in field engines.

The classification of tests relating directly to comparative evaluation in terms of anticipated engine performance may be approached in a number of ways. One convenient classification suggests a grouping according to the type of equipment involved. This classification would differentiate them as follows:—

1. Bench type tests made in a chemical or mechanical laboratory. This test equipment is often quite extensive and may include small engines.

2. Engine tests using either small or full scale engine or prototypes of full scale engines.

3. Field tests involving commercial units in existing commercial operations or simulations thereof.

This group of evaluation methods could also be classified according to the particular characteristics or combination of characteristics for which the lubricant is being evaluated. In practice, no individual trait can be distinguished in the tests previously outlined. The test procedure is usually defined to accent the severity in the direction of the particular characteristics in question. The products and effects of lubricating oil deterio-

Table II. Detergency Tests

33. Union Detergency (Soiled Cloth).
34. Shell Detergency Test.
35. Centrifugal Detergency Test. *Industrial and Engineering Chemistry*—Feb. 15, 1943, page 91. "Lubricating Oil Detergency." S. K. Talley, R. G. Larsen—Shell Development Company.
36. Infra-Red Detergency Test.
37. Wood River Detergency Test.
38. Chromotagraphic Detergency Test.

Table III. Corrosion Tests

39. Underwood Oxidation and Corrosion.
40. Shell Corrosion and Stability (Wood River Felt Pad and Bearing). *Industrial and Engineering Chemistry (Anal.)*—Sept. 15, 1943, page 550. "Potential Service Performance of Lubricating Oils." G. W. Waters, E. C. Larson—Wood River Laboratories.
41. Shell Corrosion and Stability (Shell Thrust Bearing and Corrosion). *National Petroleum News*—Sept. 17, 1941, page R294. "A Laboratory Machine For Investigating Corrosion of Bearings." G. K. Talley, R. G. Larsen, W. A. Webb—Shell Development Company.
42. U. S. Bureau of Mines Corrosion (strip corr.).
43. MacCoull Corrosion. *SAE Transactions*—Aug. 1942, page 338. "An Oil Corrosion Tester." N. MacCoull and A. C. Scholp—Texas Company and E. A. Ryder of P. & W. Aircraft.
44. Pratt and Whitney Corrosion.
45. Strip Corrosion.

ration are all more or less related and could be grouped under the heading of "Oil Stability." The following table conveniently separates oil deterioration into characteristic groups:—

1. *Oxidation or polymerization stability.*
2. *Detergency or dispersancy.*
3. *Corrosion resistance.*
4. *Load-carrying ability or resistance to scratching, scuffing, etc.*
5. *Such specific properties as:*
   - *a. Piston ring sticking*
   - *b. Ring band deposits*
   - *c. Ring groove packing*
   - *d. Piston under-crown deposits*
   - *e. Piston ring slot plugging*
   - *f. Varnish and lacquer formation*
   - *g. Sludge formation*
   - *h. Filter or strainer sludging*
   - *i. Two cycle engine port clogging*
   - *j. Alloy bearing corrosion*
   - *k. Valve sticking*
   - *l. Valve deposits*
   - *m. Cylinder wall scratching, scuffing*
   - *n. Piston ring scuffing, scratching*
   - *o. Bearing corrosion*
   - *p. Bearing seizure or failure*

Oxidation and polymerization of an oil are accelerated in an engine by the heat resulting from combustion and from friction. Oxidation results from a combination of the oil with oxygen in the engine, the oil being exposed to the oxygen while in a thin film or a fine mist and to the oxygen carried in the oil streams. Oxidation productions include sludge, varnish, carbon, organic acids, asphalts, asphaltenes, and a multitude of other oil soluble and insoluble materials, the composition of which is difficult of analysis. Polymerization is the combining of the same kind of molecules to form other compounds having the same elements but a higher molecular weight and different physical properties. These compounds are not products of oxidation but do undoubtedly contribute to the formation of sludge, varnish, and oil soluble and insoluble materials.

Detergency and dispersancy as used by the Industry are loosely applied. However, they refer to the property of the oil to hold insoluble material in suspension and prevent the deposition of both soluble and insoluble resins on interior engine surfaces.

Table IV. Film Strength—Oiliness—Load Carrying—Etc.

46. U. S. Bureau of Standards (Four Bearing). *SAE Transactions*—1927, part No. 1, page 73. "Effect of Abrasives in a Lubricant." S. A. McKee, Bureau of Standards.
47. Almen.
48. Falex. *Institute of Petroleum J.*—Dec., 1939, page 761. "Extreme Pressure Lubricant Tests with Pretreated Pieces." J. P. Baxter, C. J. Snow, J. T. Pierce—Imperial Industries, Ltd.
49. SAE. *SAE Journal*—1936, page 293. "Extreme Pressure Lubricants Testing." G. L. Neely—Standard Oil Co. of California.
50. Lubarometer.
51. Timken (Scoring and Scuffing). *SAE Transactions*—1931, page 491. "Observations on the Testing of Lubricants." E. Wooler, Timken Roller Bearing Company.
52. Timken (abrasion).
53. Adheroscope.
54. Shell "4 ball . . ."
55. Westinghouse Friction Machine. *Industrial and Engineering Chemistry*—May, 1926, page 465. "The Role of Oiliness in Industrial Lubrication." W. C. Wilhorm—Westinghouse Electric.
56. Gear Scuffing Machine.
57. Sibley Bearing Machine.
58. Caterpillar Bearing Machine.
59. Navy Work Factor Machine.
60. Stephens Consistometer.
61. Wilson and Barnard Static Friction.
62. Deeley Friction Test. *Institute of Petroleum J.*—Jan., 1940, page 1. "The Static Friction of Lubricated Surfaces." A. Togg, S. A. Hunwicks.
63. Floyd Load Carrying Machine.
64. Kinetic Oiliness Testing Machine.
65. Weeks Wear Test.
66. Weeks Film Strength Machine.
67. Standard Oil Company of N. J. Film Thickness. *Industrial and Engineering Chemistry*—May, 1926, page 471. "Surface Action and Fluid Film Lubrication." A. E. Becker—Standard Oil Company.
68. General Electric Fluid Friction. *Industrial and Engineering Chemistry*—May, 1926, page 467. "Some Little Understood Factors Affecting Lubrication." E. G. Gilson—General Electric Company.
69. General Electric Bearing Machine.
70. Wright Aero Bearing Machine. *SAE Journal*—Feb., 1937, page 48. "Selection of Oils for High-Output Aircraft Engines." A. L. Beall—Wright Aeronautical Corp.
71. Standard Oil Kinetic Oiliness (Model B). *SAE Transactions*—Dec., 1937, page 548. "High Oiliness—Low Wear." G. L. Neely—Standard Oil Company.
72. Penn State College Oiliness Machine. *SAE Transactions*—Nov., 1937, page 531. "High Pressure Viscosity as an Explanation of Apparent Oiliness." H. A. Everett—Pennsylvania State College.
73. Shell Pendulum. *Journal of Applied Physics*—July, 1941, page 512. "The Physical Aspects of Boundary Lubrication." O. Beeck—Shell Development Company.
74. Cornell-Olson Bearing Machine. *SAE Transactions*—1926, part No. 1, page 68. "Effects of Dilution on Bearing Friction and Temperature." A. LeRoy Taylor—University of Utah.
75. U. S. Bureau of Standards (Two Steel Roll). *SAE Transactions*—1933, page 402. "Apparatus for Determining Load Carrying Capacity of E. P. Lubricants." S. A. McKee, F. G. Bitner, T. R. McKee.
76. U. S. Bureau of Standards (Liberty Crank Pin Bearing). *SAE Transactions*—1926, part No. 2, page 248. "The Effect of the Addition of Kerosene on the Oiliness of Lubricating Oils" S. A. McKee—Bureau of Standards.
77. U. S. Bureau of Standards (Three Ball and Plate). *SAE Transactions*—1925, part No. 2, page 95. "Machine for Comparing Lubricating Properties of Oils." C. F. Marvin, Jr.—Bureau of Standards.

Corrosion resistance is closely related to oxidation resistance since corrosive organic acids are usually formed by oil oxidation. However, its significance is great enough to consider separately. Corrosive products of oil deterioration are usually evidenced by disintegration of alloy type bearings.

The load carrying ability of an oil in an engine unfortunately does not follow the classical interpretation of dynamic lubrication. The latter concept considers a perfect, unbroken fluid film where the relative speed of the two surfaces, the viscosity of the fluid and the applied pressure are the only variables affecting the performance of the lubricant. Thus, the load carrying ability of an oil could be readily predicted if this perfect oil film condition existed. Since only a partial film exists between the rubbing surfaces in an engine, the amount of film and character of rubbing surface enter into the overall concept. The phenomena becomes one of considerable conjecture as evidenced by the large number of different types of mechanisms designed to study and evaluate these characteristics.

It is probably safe to say that a metal surface exposed to oil absorbs a certain amount of the oil to give a film probably a few molecules in thickness. It is probable that this molecular film is in the nature of a plastic solid and resists the action of the surfaces to squeeze it out. At the point in a bearing surface where the appreciable oil film has been ruptured, this molecular film or boundary type lubrication plays a variable part depending upon the multitude of conditions existing between the surfaces at the point of film rupture. Ultimate failure or seizure probably occurs when "boundary lubrication" no longer wets and separates the surfaces and metallic contact occurs.

Although the many bench type tests do not indicate a single specific property of an oil, they may be conveniently grouped according to the characteristics which they predominantly demonstrate. For instance, under "oxidation" tests, such tests as the Indiana, Sligh and British Air Ministry may be included. Tables I through IV are presented to illustrate some of the bench tests available for demonstrating predominant characteristics under the following groupings:—

Detergency tests
Oxidation tests
Corrosion tests
Load-carrying tests

Tables I and II (p. 10 and 11,) present parallel data regarding engine tests and illustrate the range of operational procedures and the oil characteristics which are evaluated by the many engine tests. These latter tables are reproduced from a paper first presented before the SAE.

In some cases small deposits of sludge and varnish may not be objectionable. Generally these deposits interfere with heat transfer, reduce working clearances and may clog oil screens and small oil passages. Ring sticking and ring groove packing may be the most serious result of the use of an oil unsuitable in these respects. The increased use of high load-carrying alloy bearings necessitates the use of oils resisting the formation of corrosive organic acids or calls for the use of oils which include some protective agent for the bearings should the corrosive acids be formed.

Table I

Oil Inspection Information Determined	Cat. Single Cylinder	Cat. D4400	Chevy.	G.M. 71	Lauson
Oxidation resistance (general)	X	X	X	X	X
Thermal deterioration resistance	X	X	X	X	X
Detergency (general)	X	X	..	X	X
Dispersive action	X	X	X	X	X
Sludge formation (general)	X	X	X	X	X
Filter sludging	..	..	..	X	..
Strainer sludging	X	X	X	X	..
Varnish formation	X	X	X	X	X
Ring groove packing	X	X	..	X	..
Piston under-crown coke formation	X	X	..	X	X
Ring sticking	X	X	..	X	X
Air-port plugging	..	..	..	X	..
Bearing corrosion	X	X	X	X	X
Wear resistance	X	X	..	X	..
Anti-scratch, anti-weld	X	..	..	..	..
Run-in protection	X	..	..	X	..
Cylinder scuffing	X	..	..	X	..
Cylinder grooving	..	..	..	X	..
Valve sticking	..	..	..	X	X
Viscosity increase	..	..	X	X	X
Effect of T. E. L.	..	..	X	..	X
Effect of Air-Fuel ratio	X	..	X	..	X
Effect of sulphur in fuel	X	X	X	X	X
Piston crown scuffing	X	X	..	..	..
Oil ring slot plugging	..	..	X	..	..

(Penfold, Sept. '44.)

One shortcoming of most bench-type tests, resulting in their failure to correlate with full-scale engine performance, is their inability to take into account the many variables which influence engine operation. Some of the most important variables may be introduced by the fuel the engine is supplied with. Recent investigations have shown marked differences in engine and lubricating oil performance for different fuels, and both gasoline and Diesel fuel properties contribute to this difficulty. Low engine operating temperatures seem to accentuate troubles traceable to the fuel. Fortunately, engine tests may be devised to demonstrate these effects and the total knowledge of engine, fuel and lubricating oil performance be broadened.

The expression "bench test" is a rather broad term defining a conveniently operated, relatively inexpensive piece of test equipment. It is designed to supplement or replace the more elaborate, time-consuming and expensive type of equipment such as semi or full scale test engines. For this reason considerable effort is being directed toward its perfection. The equipment ranges from small, simple containers wherein a sample of oil is heated, to small engines which are mounted on a bench and are convenient to operate and handle.

Excluding small engine types, bench tests for studying oil deterioration usually start with a small sample of oil heated in a suitable container. Thereafter the method depends upon the particular characteristics of the oil being investigated and upon the opinion of the investigator. The procedures usually involve one or more of the following operating factors:

1. A small definite sample of oil to be tested is placed into a suitable container of glass or other material. The container is placed into a heating bath which often accommodates several such containers.
2. The bath is maintained at some constant ele-

vated temperature or is periodically cycled through a range of temperatures.

3. Gas is bubbled through or is passed over the oil sample at controlled rates of flow to accelerate and control the rate of deterioration.
4. The oil sample is agitated by controlled stirring or other means to insure uniform reaction.
5. Metal or metallic compounds are placed in the oil sample to simulate the catalytic effect of metal surfaces in an engine. In some cases the oil container is metal and forms the catalytic surface. If the corrosiveness of deterioration products is to be observed, bearing metal is often placed in the bath and may perform the function of the catalyst.
6. Deteriorated crankcase oil or products of engine fuel combustion are mixed with or periodically added to the original sample to further simulate actual engine conditions.
7. Polished strips of glass or other material are hung in or over the oil sample as a method of observing the rate of varnish formation.
8. The length of time of testing varies widely and is largely governed by the opinion of the investigator as indicated by trials on both satisfactory and unsatisfactory oils.
9. Suitable instruments are installed to conveniently control these variables and often record the rate of certain reactions as the test progresses.

(Continued on page 32)

TABLE II

	Type	Fuel	Number of Cylinders	Bore (inches)	Stroke (inches)	Operating Cycle (stroke)	Normal Speed (RPM)	Normal Used Oil Sump Temp. (° F.)	Cooling	Normal BMEP or BHP	Jacket Temp. Normally Used	Minimum Jacket Temp.	Length of Test (hours)
Atlas-Lanova	C1	D	1	3.125	3.75	4	1800	135	L	76	175	*	300
Caterpillar (Special)	C1	D	1	5.75	8.0	4	1000	150	L	75	175	325	40 min. to 4000 hrs.
Caterpillar (D4400)	C1	D	4	4.25	5.50	4	1400	210	L	75	205	275	24 to 240
Chevrolet (Pass. car)	S1	LG	6	3.5	3.75	4	3150	265 280	L	30 HP	200	325	20 to 500
Cummins (H)	C1	D	4-6	4.875	6	4	1600	170	L	70	175	*	250
Delco (8EW3)	S1	WG	1	2.312	2.562	4	1800	*	L	800 W	212	300	48
Ethyl (Series 30)	S1	LG	1	2.5	4.625	4	1200	175	L	*	212	400	*
Fairbanks Morse (36A)	C1	D	1	4.25	6	4	1200	240	L	9.3 HP	175	350	24
Fairbanks Morse (38-D8)	C1	D	9	8.125	10	2	900 (max.)	155	L	*	150	*	250 to 500
General Motors (71 Series)	C1	D	$1_3 4_6$	4.25	5.0	2	2000	230	L	26.5 HP/Cyl.	180	*	50 to 500
General Motors (268-A)	C1	D	8	6.5	7.0	2	1300	150	L	*	150	*	250 to 500
General Motors (248-A)	C1	D	16	8.75	10.5	2	800 (max.)	155	L	*	150	*	250 to 500
Gulf (L-Head)	S1	G	2	3.125	4.375	4	3770	*	L	27.5 HP	*	*	*
Gulf (I-Head)	S1	G	2	3.125	4.375	4	3250	*	L	27.5 HP	*	*	*
Gulf (Air-cooled)	S1	G	1	3.875	3.625	4	*	*	A	*	*	*	*
Harley Davidson (45)	S1	LG	2	2.75	3.81	4	3000	*	A	10 HP	*	*	50
Hercules (DOOD)	C1	D	4	4.25	4.50	4	1600	*	L	*	*	*	50
International Harvester (UD14)	C1	D	4	4.75	6.50	4	1350	225	L	52 HP	205	*	500
JAP	S1	WG	1	2.56	3.15	4	3000	*	A	100	*	*	*
Lauson (LF822)	S1	LG-WG	1	2.62	2.62	4	1800	160 to 300	L	1 to 2.5 HP	170 to 400	*	12 to 240
Waukesha (CFR)	S1	G	1	3.25	4.50	4	1200	*	L	*	*	275	50
Winton (201A)	C1	D	1 12	8	10	2	750	150	L	Appr. 80	150	*	250 to 2500
Wright (R975)	S1	LG	9	5.0	5.5	4	2400	*	A	160	*	*	*

*Indicates information not available or confidential.
C1—Compression ignition. S1—Spark ignition. D—Diesel. G—Gasoline (white or leaded). L—Liquid. A—Air.

A Method For Testing Cutting Oils*

By H. L. MOIR, J. S. YULE, D. J. WANGELIN AND R. J. MOYER

The Pure Oil Co.

In order to have a method of selecting proper cutting oils for various machining operations with different materials it is convenient to have a means of comparing machinability with oils of different kinds. Considerable investigation has been done with dry cutting but the amount of information as to the performance of cutting oils is limited.

Tool life tests have been used for dry machinability testing by various investigators and have proven to be very successful. In order to simplify the test procedure, single point tools are used on a lathe for this work. The tests may be accelerated by using high cutting speeds so that the tool life is short, thereby saving both time and material. In the usual method of running these tests the relation between tool life and cutting speed is obtained so that a curve may be plotted through the points. When tool life is plotted against cutting speed on logarithmic graph paper it is found that the points fall along a straight line. It is thought that, by extrapolating the curves, fairly accurate values of cutting speeds for longer tool lives may be obtained.

Tool life is defined as the length of time during which the tool will cut efficiently and it is usually coincident with the breakdown of the cutting edge. Due to the fact that high speeds are used, the tool failure occurs very abruptly. This is shown in Figure 1. Figure 1a shows a new tool, and Figure 1b is the tool after it has been cutting for 7¾ minutes. Attention is called to the fact that the contour of the nose is still nearly the same as that of the new tool. Fifteen seconds after the condition shown in Figure 1b, the cutting edge was completely broken down, as shown in Figure 1c. This tool was used dry on SAE 1045 steel with a 0.050-inch depth of cut, a 0.0094 inches per revolution feed, and a cutting speed of 166 feet per minute. If the tool were reground before complete failure considerable tool steel could be saved.

Attempts have been made to evaluate cutting oils by comparing results of tool life tests for oil and dry cutting. Comparison is made on the basis of percent increase in cutting speed for a given tool life or percent increase in tool life at a given cutting speed. This allows for variations in dry machinability due to slight variations in metal analysis or heat treatment. It has been found that the results obtained in these tests cannot always be correlated with field results and it is thought that the discrepancy lies in the type of tool failure used. Complete breakdown of the cutting edge is rarely used as a tool life criterion in the field. In fact, the tools are usually reground when the finish becomes poor, which may be long before complete tool failure. We have found that the relation between usable finish and tool life is not the same for all oils. For example, two oils may produce the same tool life at a given cutting speed, but the finish life for one oil may be considerably longer than for the other oil. We have devised a test which rates oils according to finish life as well as tool life.

Finish life is defined as the length of time that a tool will cut at a given speed without appreciable change in finish. It is either less than or equal to tool life. Finish life may be determined by visual inspection or by measurement of the surface roughness with a suitable instrument. It is often possible to find pronounced visible finish changes, when cutting with oil, long before the tool has completely failed. Such a failure of the finish is shown clearly in Figures 2a and 2b. In Figure 2a it can be seen that the tool produced a length of cut of about twelve inches and that complete tool failure occurred at the point B. The finish changed at the point A so that it is very rough for the last two inches of the cut. Figure 2b

* *Presented before the War Engineering Meeting of the Society of Automotive Engineers in Detroit. Published here for the first time, with the permission of the S.A.E.*

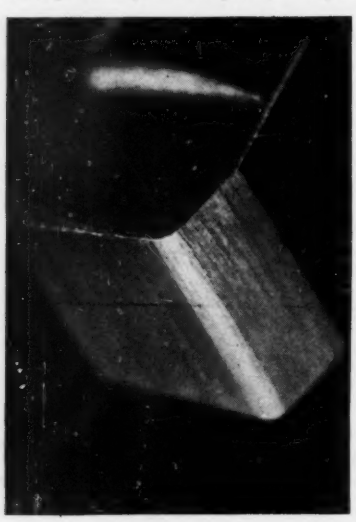


Figure 1a

Figure 1b

Figure 1c

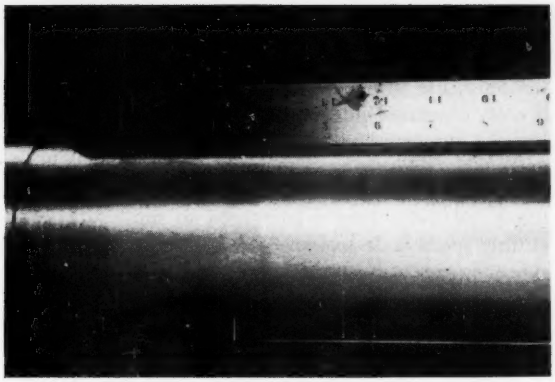


Figure 2a

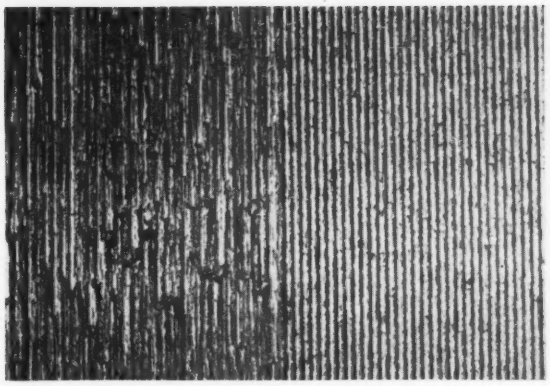


Figure 2b

is an enlarged view of the distinct finish change at Point A. Unfortunately the finish changes are not so easily noticeable at higher speeds or with dry cutting so that visual inspection is not sufficient for these tests. It is also difficult to measure any change in depth of cut due to tool wear.

In an attempt to detect these noticeable finish changes we have devised an instrument, shown in Figure 3, which we call a surface comparator. It consists of three principal parts—the pickup unit, the amplifier, and the meter. The pickup unit is shown in Figure 3c and is made from a phonograph crystal cartridge with a sapphire-tipped needle. The pickup arm is free to rotate on a journal. The arm is counterweighted so that the pressure on the needle is about two ounces. When the surface comparator is in the operating position, as in Figure 3b, the lathe cross slide is set in such a position that the needle is directly over the axis of the work. By adjusting the collar in Figure 3d, the pickup unit may be moved vertically so that the needle will remain in the same relative position to the work as the work diameter decreases. A pin in the collar fits into a support so that the needle can only move a few thousandths of an inch from side to side. This small movement is desirable so that the needle can find the groove made by the tool. The needle is made to travel in the cut by using the same feed per revolution that was used when the cut was made. Finish readings are made when running the lathe at a speed of about thirty surface feet per minute. The slow speed is used so that the needle wear is minimized. The pickup unit is connected to the amplifier and the meter shown in Figure 3a. The meter reading gives an indication of relative roughness, the higher the reading the rougher the surface.

A true indication of relative roughness is obtained only if the finish is all of the same type. If, for example, the finish changes from a uniform groove to a torn surface, the true character of the finish will not be shown. The reason for this apparent discrepancy can be found in Figures 17, 22, 23, and 24. Figure 17a is a photomicrograph of the finish of the most common type at 25X magnification with side lighting. The tool has made definite feed lines or grooves so that the finish is quite uniform. Figure 17b is the same surface with the lighting parallel to the grooves. In the picture numerous microscopic irregularities are shown, over which the needle of the surface comparator must ride. It is the size and frequency of these irregularities which determine the reading obtained with the instrument. Figures 23a and 23b show a rougher surface of the same type. It is evident that the reading for this surface should be higher because of the larger irregularities in the surface. Now if we consider a torn surface as shown in Figures 24a and 24b it can be seen that, although the surface is visibly poorer, the irregularities over which the needle passes are fewer than in either of the above examples. Therefore, we may expect a lower reading. Occasionally, the tool fails by wearing of the front clearance, so that the finish is burnished by a flat surface of the tool. Figures 22A and 22B show the finish in such a case. Obviously, this surface will produce a low finish reading—in fact, it actually is smoother, but it is an indication of a type of tool wear which will change the depth of cut. From these examples it may appear that the finish changes are diffi-

Figure 3a

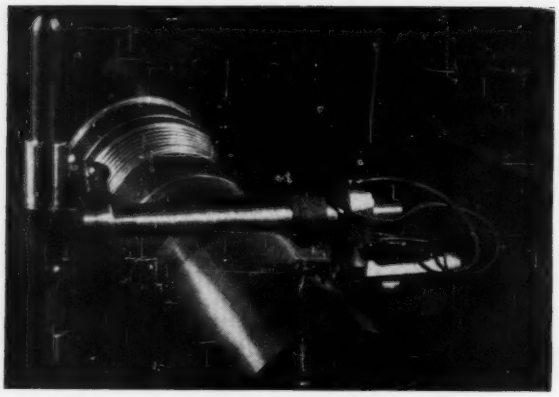


Figure 3b

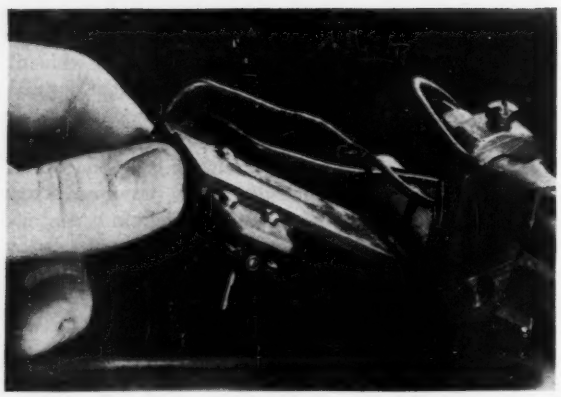


Figure 3c

cult to detect. It is, however, found to be comparatively simple when it is remembered that changes in type of finish are easily visible.

Finish life tests are run in conjunction with tool life tests so that a comparison may be made between the two. The tools are first run to tool failure and then the surface is inspected for finish failure. After each tool has been run, the surface is marked off into half-inch increments. Finish measurements are made at each mark so that finish readings may be plotted against length of cut. The plotted points are connected with straight lines so that a broken line curve is produced. Figure 4 shows the curve produced from the readings taken from one of the cuts on oil "C". At the Point "A" a visible finish change was noticed. Attention is called to the fact that the finish did not change much up to this point. Figures 17 to 22 inclusive show the character of the finish at several points numbered 1 to 6 along the cut. The finish is very nearly the same until the point marked for finish change is reached.

Figure 5 is a similar curve for one tool cutting dry. In this case there were no visible changes but the finish is found to be noticeably poorer after the point "A" than before it. Therefore, the point "A" is taken as the point of finish failure. For this cut tool life was 19.34 minutes and finish life was 7.15 minutes. Notice that when cutting with oil "C" the finish life is considerably longer than with dry cutting although the tool life is nearly equal.

When the points of finish failure have been determined for each cut from the curves, the finish life can be calculated by multiplying the tool life by the ratio of the distance to finish failure to distance to tool failure. After the finish life is known for several speeds, the finish life is plotted against cutting speed on logarithmic paper. A straight line may be drawn through the points as is done with tool life points. The finish curve usually has a greater slope than the tool life curve, indicating that tool life is relatively longer compared to finish life as the cutting speed is decreased. As the tool life becomes very short the finish life approaches the tool life. Obviously, since the finish life can never be greater than tool life, the finish curve can never cross or lie above the tool life curve.

Relative quality of oils may be somewhat different when finish life is used as a criterion instead of tool life. Figure 6 shows the tool life curve for oil "A". The percent increase in cutting speed over dry cutting at 300-minute tool life is 8.3 for oil "A". The percent increase in cutting speed over dry cutting at 300-minute finish life is 17.5. From this it can be seen that oil "A" has a much better rating on a finish life basis than it does on a tool life basis, as shown in Figure 7.

Comparison of oils may be quite different when finish life is used instead of tool life. Figures 8 and 10 show the tool life curves for oils "B" and "C" respectively. For oil "B" the percent increase in cutting speed over dry cutting at 300-minute tool life is 23.7 and for oil "C" it is 27.2. When these oils are compared on this basis their performance is quite similar. However, when the comparison is based on finish life the performance of the oils is quite different. Figures 9 and 11 are the finish life curves for oils "B" and "C" respectively. For oil "B" the percent increase in cutting speed over dry at 300-minute finish life is 11.8 but for oil "C" it is 35.8. Obviously, oil "C" is much better than oil "B" for finish cuts, but the tool life test does not show this to be so. In all cases the slope of the finish life curve is greater than that of the tool life curve. Oils producing good tool life are satisfactory for roughing cuts where finish is not important.

Another item of importance in cutting oils is the quality of the finish produced. Some oils produce a surface finish which is rough whereas others produce a smooth finish. We have developed a method whereby the finish with oil may be compared with the finish with dry cutting. For this test we use the same type of tools as for tool life tests and the same feed and depth of cut. Three tools are run with oil and three dry. Each tool is

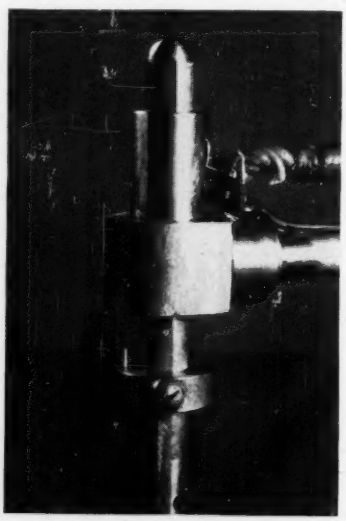


Figure 3d

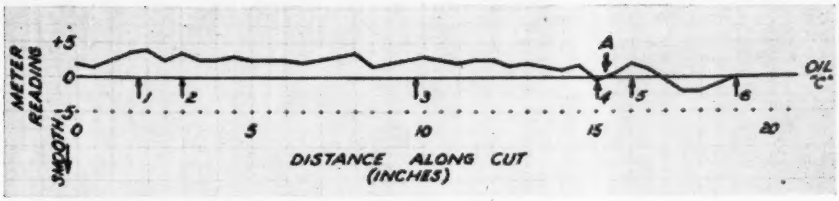


Figure 4

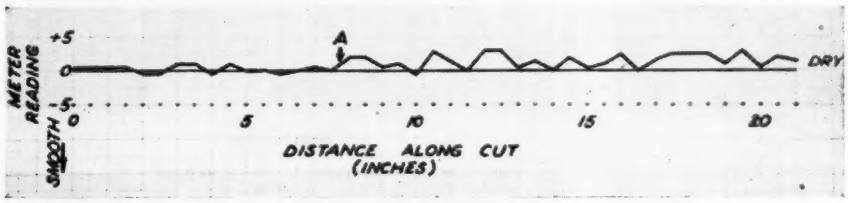


Figure 5

run at speeds of 50, 100, 150, 200 and 250 feet per minute in that order. The second is run at the same speeds but in the order 100, 200, 50, 250 and 150. The third run in the order 150, 250, 100, 50 and 200. The same sequence is used for both oil and dry cutting.

It is necessary to have all the tools run at the same diameter and section of the test bar so that all the finish readings may be taken without changing any part of the setup. The readings for each speed are averaged and smooth curves are plotted for both oil and dry cutting. The area between the curves is used as a means of classifying finish.

In addition to finish classification, which shows the overall performance from 50 f.p.m. to 250 f.p.m., another basis of comparison is used which is called finish variation. This evaluation consists of five numbers representing the difference between the curves at the five speeds. In order to better visualize this data a graph is drawn with dry cutting represented by a straight line. This makes comparison between different oils easier because the shape of the dry curve is always the same and therefore does not influence the oil curves.

The results of the test on oil "C" are shown in Figures 12a and 12b. Attention is drawn to the fact that the finish with oil cutting is better at 50 feet per minute cutting speed than at 100 feet per minute, while the finish with dry cutting is better at the higher speed. Figure 13a is a photomicrograph of the finish at 50 feet per minute dry. Observe that the finish at the lower speed is rougher as the curve of Figure 12 indicates. Figure 14a is the finish with oil "C" at 50 ft./min. and 14b is at 20 ft./min. It can be seen that the lower speed gives a smoother finish with oil than the higher speed. Also the finish at 50 ft./min. with oil "C" is smoother than at the same speed with a dry cut. At 120 ft./min. the dry cut is smoother than the oil cut.

It would seem that dry cutting is better than cutting with oil because it produces a smoother finish. However, if it is remembered that for the same tool life or finish life higher speeds are permissible with oil, better finish can be obtained with oil than with dry cutting.

In all these tests the same type of tools were used. They were made of Rex AA high-speed steel of the following shape:

6 *degree back rake*
8 *degree side rake*
8 *degree front relief*
8 *degree side relief*
8 *degree end cutting angle*
5 *degree side cutting angle*
1/32 *inch nose radius*

Additional tool life tests were run at constant cutting speed with varying side rake angles from zero to forty degrees. With a test of this type we expected tool life to be low for zero side rake and to increase as side rake increased up to a maximum after which point the cutting edge would be weakened causing the tool life to decrease again. We found this to be true except that with different types of oils the peak occurred at different angles. Oils containing high anti-weld in the form of active sulfur showed the best performance with low rake angles. Some idea of the function of cutting

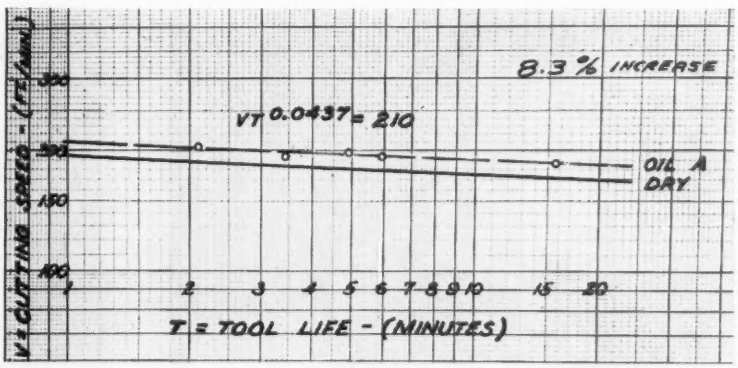


Figure 6

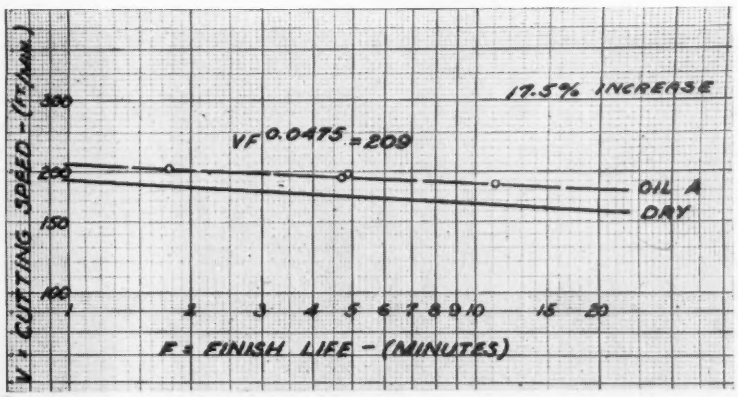


Figure 7

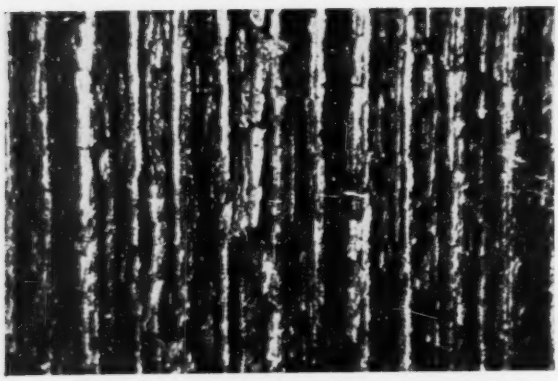


Figure 13a

Figure 13b

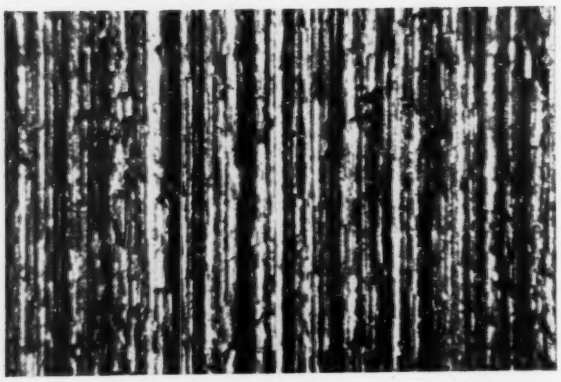


Figure 14a

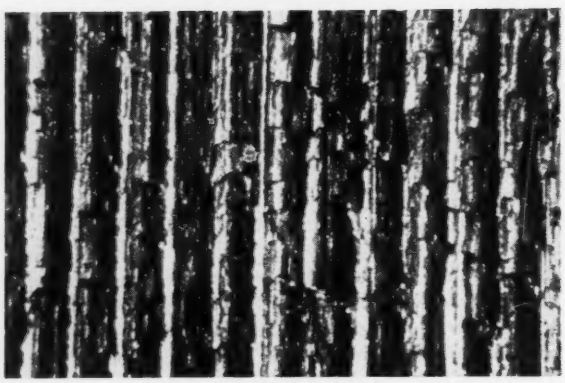


Figure 14b

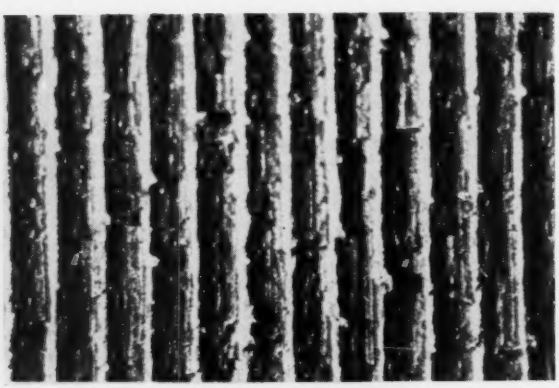


Figure 17a

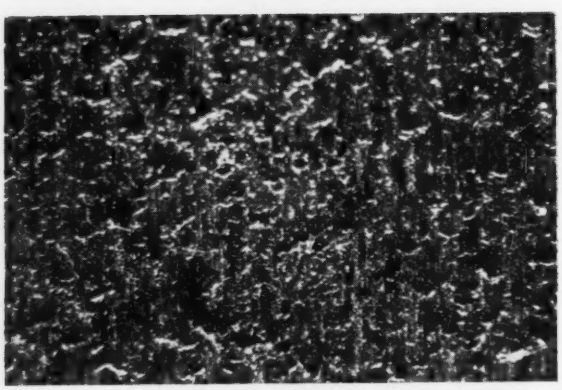


Figure 17b

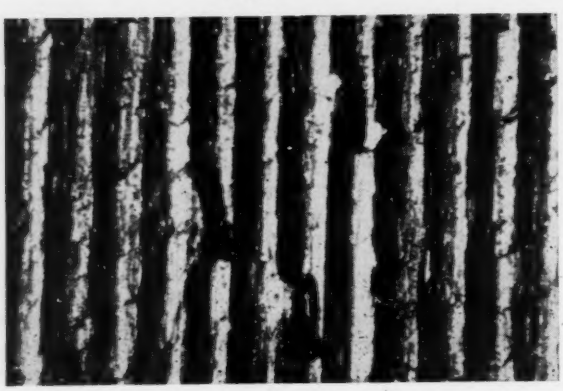


Figure 18a

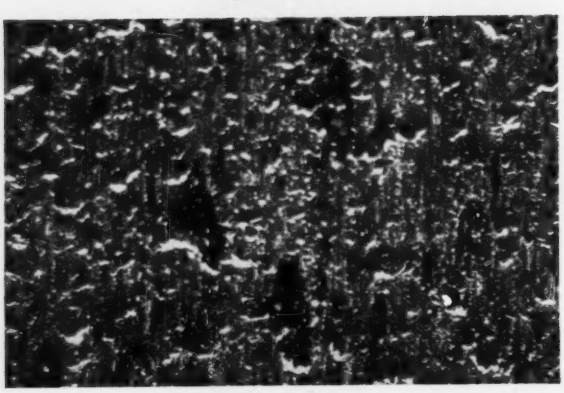


Figure 18b

Figure 19a

Figure 19b

Figure 20a

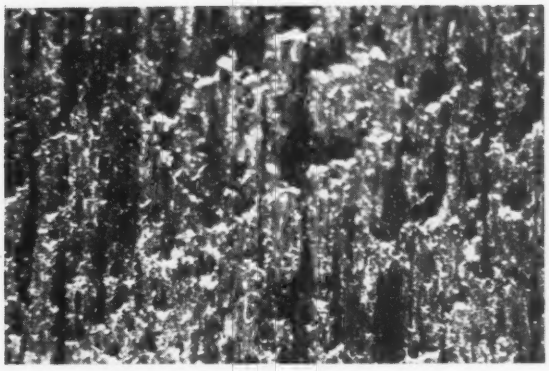


Figure 20b

Figure 21a

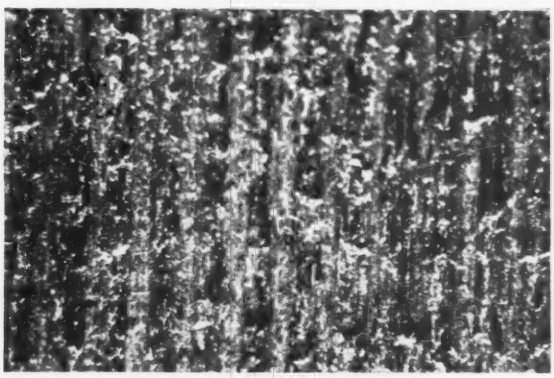


Figure 21b

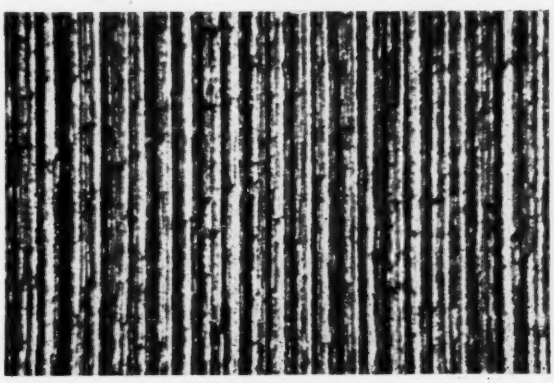


Figure 22a

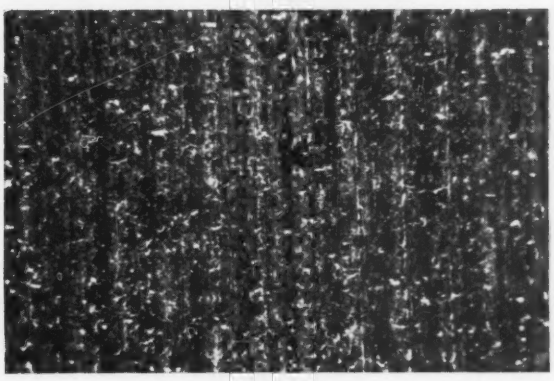


Figure 22b

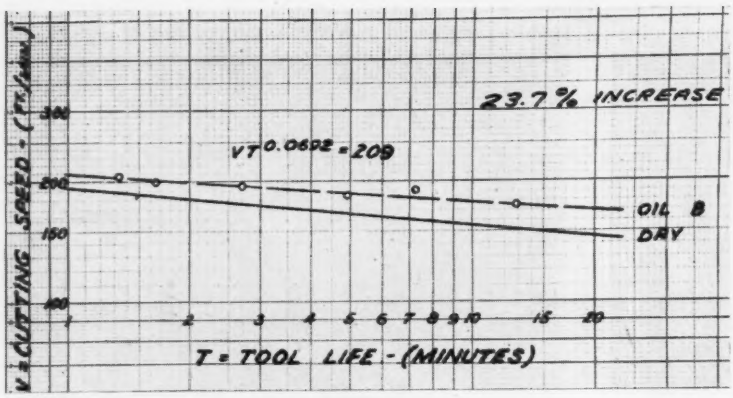


Figure 8

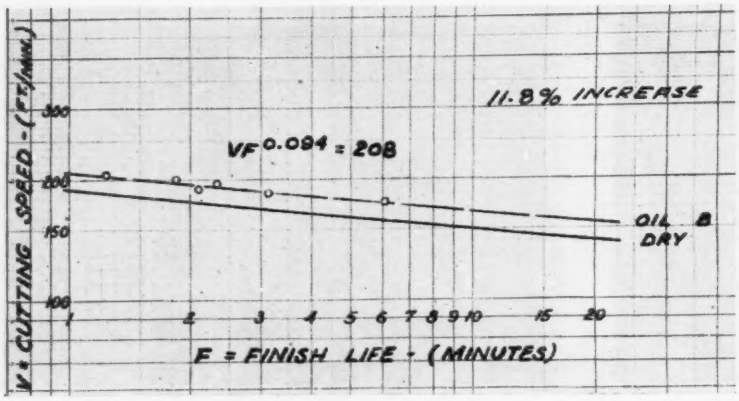


Figure 9

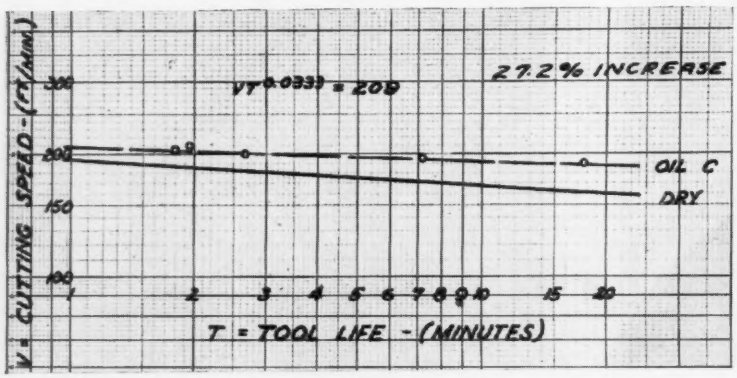


Figure 10

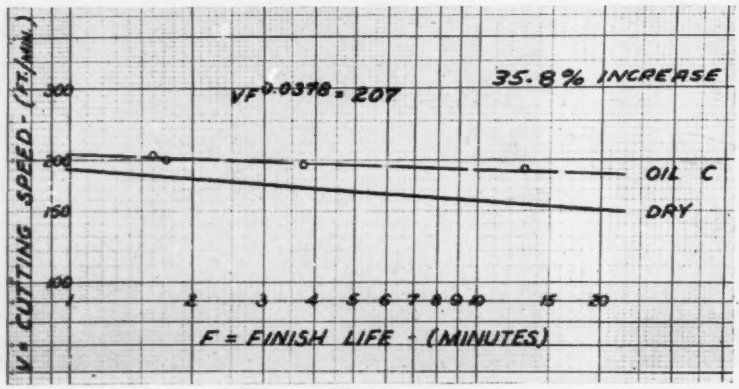


Figure 11

oil may be had by studying the chips formed when cutting with and without oil at different rake angles. For example figure 25a shows the edge of a chip formed without cutting oil when the speed was 200 ft./min. and the side rake was 14 degrees. Notice the secondary shear lines which indicate that the chip was severely deformed when striking the tool surface. This is due to insufficient lubrication causing extra work to be done on the chip. In figure 25b the cutting conditions were similar except that the side rake was increased to 22 degrees. This chip has an absence of shear lines of the type shown in the first chip. This can be accounted for by the tendency of the chip to slip over the tool surface easier because of the steeper rake angle. In figure 25c is shown a chip from an oil cut with 200 ft./min. speed and rake angle of 14 degrees. Apparently the oil has the same effect as increasing the rake angle and we conclude that the oil creates better lubrication. If there is less chip deformation, the work done on the chip will be less, resulting in a lower power output for cutting.

Some conclusions were drawn as to the practical application of cutting oils from this test. Active sulfur in an oil has the tendency to prevent seizure between the chip and the tool but requires sufficient heat to perform that duty. Chlorine in an oil increases the strength of the lubricating film and has the apparent ability to keep the chip and the tool lubricated. If the pressure becomes too great the film will be ruptured causing a condition of seizure to be present. We can say then that under light cutting operations where large rake angles are permissible that an oil should have a high lubricating quality. With heavy cutting operations where small rake angles are necessary the oil will be operating under greater heat and pressure and therefore should have a high anti-weld property. If active sulfur is present in an oil that is used for a light operation it will act as an abrasive and decrease tool life. For this reason it is important to select the correct oil for each job.

Any testing of this type where accurate values of tool life must be reproduced requires careful grinding of the tools. We use two grinding fixtures for this work which are somewhat different from the type usually used. The swing fixture shown in figure 15 is used for

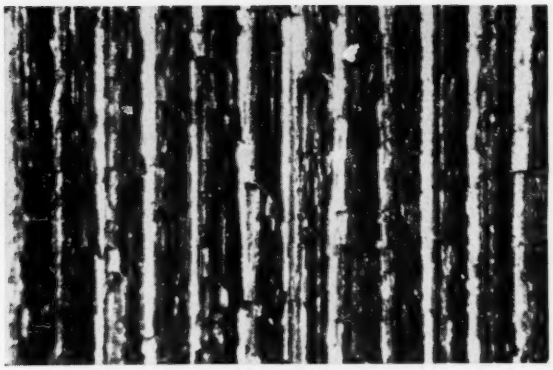


Figure 23a

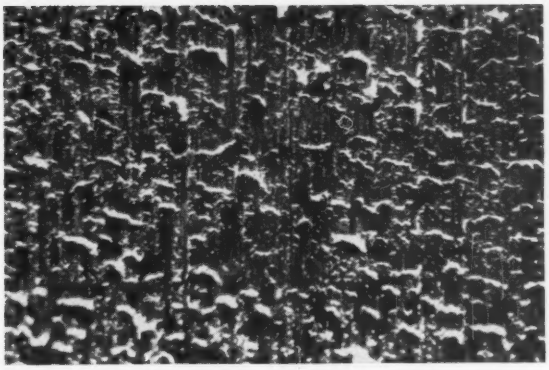


Figure 23b

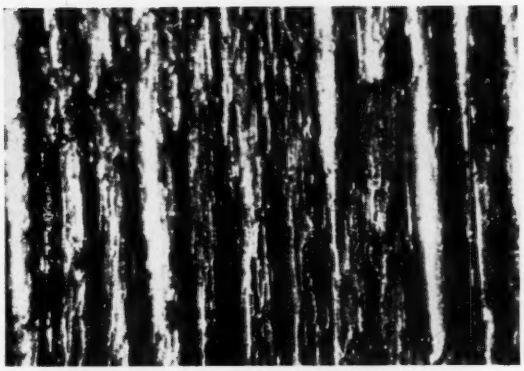


Figure 24a

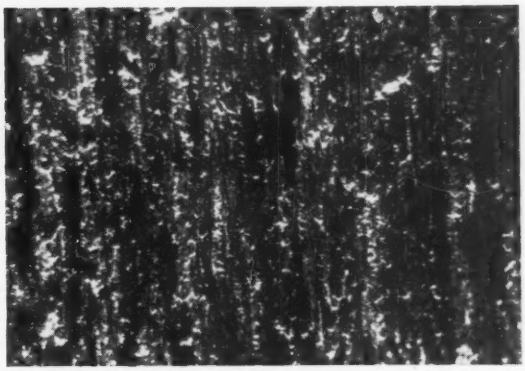
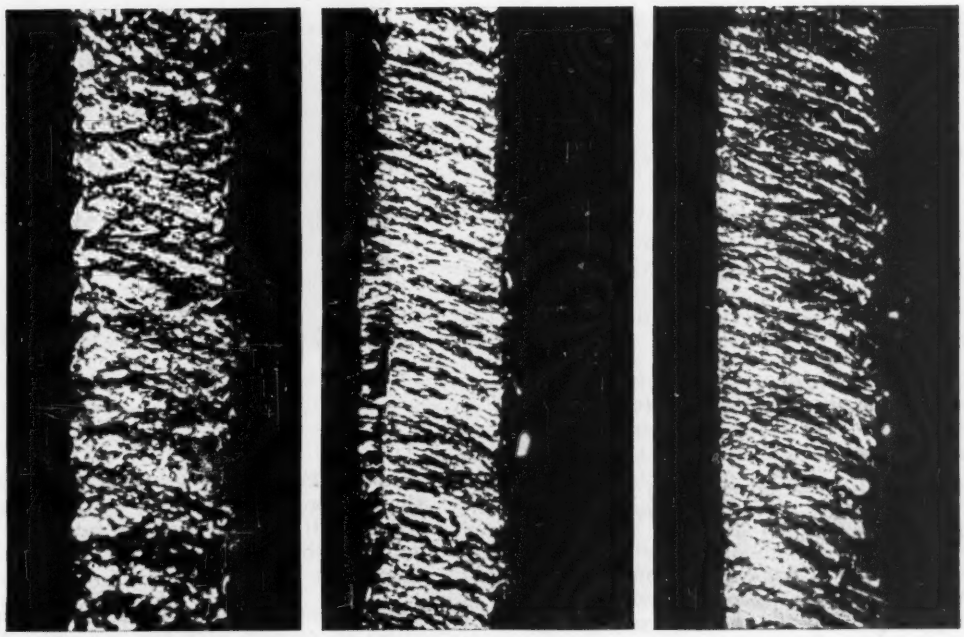


Figure 24b



a b c

Figure 25

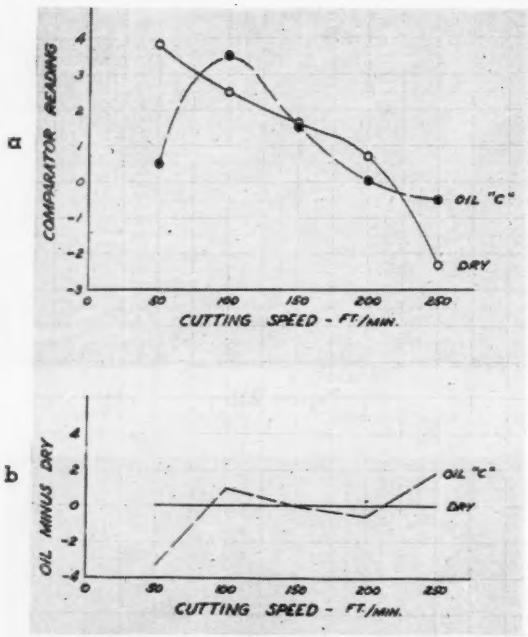


Figure 12

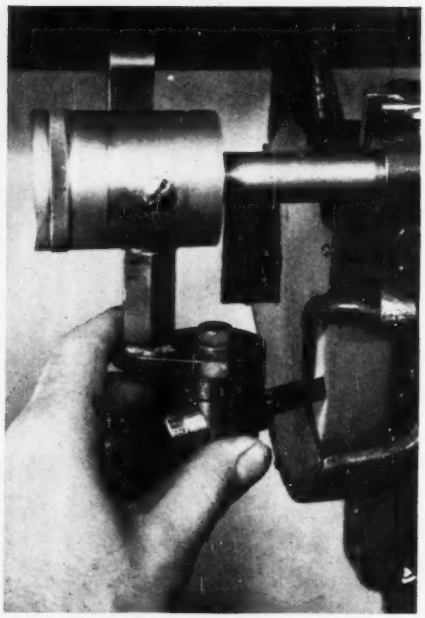


Figure 15

grinding the top, front, and flank of the tool to the correct angles. Two dial settings are sufficient for the grinding of any surface. The tool is fed into the wheel by turning the knob A. The fixture rotates about the shaft B so that the tool may be swung back and forth over the wheel surface. After the angles have been ground the nose radius is ground with the fixture shown in figure 16. The top part of the fixture can be moved independently of the base and clamped in position allowing the tool to be set in position so that both the front and flank of the tool will be plumb with the front and flank of the base. The base of the fixture is made the same shape as the tool nose so that by following the guide bar with the contour of the base the proper radius is ground on the tool.

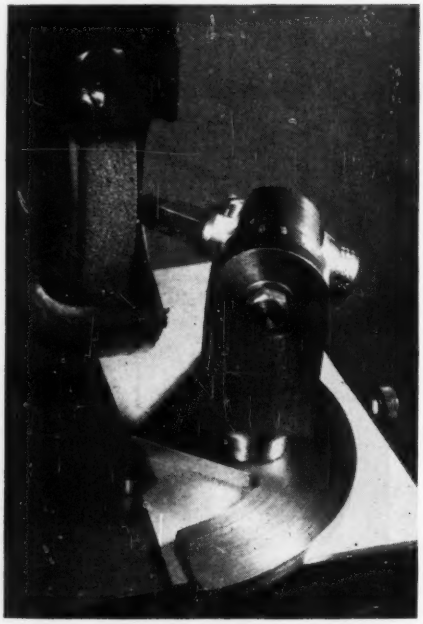


Figure 16

CONCLUSIONS

1. **Tool life tests, when applied to cutting oil evaluation, can be used to determine the value of the oil for roughing cuts where finish is not important.**
2. **Finish life is not proportional to tool life for different cutting oils and therefore tool life tests will not correlate with field tests on oils used for finishing operations.**
3. **Since finish failure is the criterion for tool regrinding on finishing operations, a test based on finish life was developed.**
4. **It being possible to have good finish life and relatively poor finish, a method was devised for comparing finish for the different oils.**
5. **The use of oil produces smoother chip flow than is obtained with dry cutting.**
6. **Heavy operations which require low rake angle should have an oil with an anti-weld agent which will prevent seizure between the chip and the tool when the oil film cannot carry the load.**
7. **Lighter operations with larger rake angles require an oil with high film strength. The usual anti-weld agents act as abrasives in this case, so that high anti-weld is undesirable.**

The Scope of Lubrication Engineering in Industry

By W. T. EVERITT*

Not too many years ago, Lubricating Engineering was unknown. Machinery was crude and massive, speeds were slow, and the overall efficiency was very poor. To keep this type of industrial equipment operating required less than half a dozen lubricants. It mattered little which lubricant was used or how it was applied; mainly by brute strength and awkwardness the industrial machine was kept moving.

The field of lubrication began to be explored by a few inquisitive individuals as industrial equipment became more complicated, speeds increased, and more reliability of performance was desired. Many engineers found that they spent their careers in creating wonderful mechanisms only to have their efforts nullified by an unsuitable lubricant, an improper method of application, or by a design which did not permit lubrication.

In recognizing the importance of lubrication some industries assigned this work as a definite function of one division, headed by a competent engineer. Thus we find that the profession of the Lubrication Engineer is rather new. In fact, it is so new, that as a group, we are publishing our first papers. For this reason, it is pertinent that we start to explore the place of the Lubrication Engineer in a manufacturing organization, the scope of Industrial Lubrication Engineering, and a few of the problems which may confront us, with some suggestions as to practical means of accomplishing this work.

*Lubrication Engineer, Eastman Kodak Co., Rochester, N. Y.

This paper, written by a Lubrication Engineer with a very broad background, explains in detail the position of the Lubrication Engineer in an industrial organization. First the engineer's basic qualifications are outlined and the several phases of his work described, then his relation with the various plant planning, operation and administrative departments are described. Numerous examples attest to the writer's qualifications to write on this interesting subject.

This paper will touch briefly on the following phases of Lubricating Engineering:

I. **The Place of the Lubrication Engineer in an Industrial Organization.**
II. **Determination of the Need for Lubcants.**
III. **Writing of Lubrication Specifications.**
IV. **Testing and Evaluation of Lubricants.**
V. **Relationship with Plant Departments:**
   (a) **Purchasing**
   (b) **Stores**
   (c) **Mechanical Design**
   (d) **Maintenance**
   (e) **Power**
   (f) **Yard and Service**
   (g) **Accounting**
VI. **Unusual Methods of Solving Plant Problems.**
VII. **Relationship with Salesmen and Technical Representatives of Vendors.**
VIII. **Outside Organization Work.**

I. The Place of the Lubrication Engineer in an Industrial Organization

In many companies lubrication and preventive maintenance programs have been left to several divisions, with no delegation of responsibility or authority. As a result, little or nothing is done and few advancements are made. Some companies who have analyzed their maintenance and production problems have found it profitable to centralize these programs in one division and have it directed by a Lubrication Engineer.

In such an organization, the Lubrication Engineer can conveniently serve as a staff member to the Chief Engineer, Master Mechanic or the Plant Manager.

As a staff member of the Mechanical Design Division, the Lubrication Engineer should have complete control over the design of lubrication systems and aid in the selection of bearings, gears, and materials of construction. Thus the equipment should get off to a good start. The Design Division sometimes has the disadvantage of being so close to the drafting board that contacts with the field are limited and a true perspective of the work is lost.

As a staff to the Maintenance Department, the Lubrication Engineer should have complete control over the selection and application of lubricants. Maintenance is a large part of the operating budget of most manufacturing concerns, and is where the results of a Lubrication Engineer's work can best be measured. He is in a favorable position to investigate repeating and unusual mechanical failures and he should get a complete overall plant operating picture. But in this department many of the Lubrication Engineer's ideas may fall on rather deaf ears. As a rule maintenance men have little time for the theory upon which major improvements are made. Their field is one of established practices which may be good or bad, plus the fact that most always they are guided by expediency. The everyday need of keeping the plant going should not stand in the way of giving a fair trial to theoretically sound practices, which, if successful, will improve the overall plant efficiency and eliminate maintenance problems.

The Lubrication Engineer in serving as staff to the Management has many advantages. From this position he can lend advice and give direction to any problem in any department that involves lubrication or preventive maintenance. Since he is not a member of the Mechanical Design or Maintenance Divisions, he does not have to defend errors in judgment of design or maintenance practice, and is in a most convenient position to adjudicate differences of opinion between the two divisions. In this position he is apt to be free to carry out some research in lubrication and to keep pace with the advancements being made in lubricants. But this picture is not all one-sided. In a staff capacity the Lubrication Engineer has a "selling" job to do in all departments with which he deals. The job of selling the lubrication program can not be too strongly emphasized. If the vast majority of interested persons are not cooperating with the program, almost every breakdown of equipment, or interruption of service will be attributed to faulty lubrication, and the entire program will be doomed to failure. Furthermore, as a staff member, the Lubrication Engineer must be ever on his guard not to be too theoretical or so far removed from the actual everyday work that he will not be able to render the desired service.

II. Determining the Need for Lubricants

Many Lubrication Engineers face a great diversity of operations:

Paper mills, rolling mills, a large variety of commercial equipment, chemical plants, steam and power generation, waterworks, refrigeration plants, machine tool operations and maintenance, metal working, fabrication shops, mechanical handling equipment, truck fleets, railways, marine engines, and in addition, an almost unbelievable amount of equipment peculiar to any specialized industry. If a grease or oil were purchased for every condition, the average plant would be overrun with special lubricants.

It is the duty and responsibility of the Lubrication Engineer to learn the characteristics of the different types of lubricants, and to be able to plan and carry out experimental work to prove the adaptability of these products with respect to his own particular operating conditions and desired service. Thus, the proper product, as indicated by its known physical characteristics and chemical stability, can be selected from approved specification lubricants. One should be constantly on the alert to sense the demands on lubricants, because if they are at all suitable for the job, it takes from one to three years to truly measure their value. Some of our greatest improvements have been made by violating the accepted practices and recommendations of machine and lubricant manufacturers. This calls for exacting and representative tests with constant follow-up to prevent difficulties until it has been demonstrated that the new practice is satisfactory. In doing this, we do not intend to criticize vendors of equipment or lubricants. In selling their products over the world they must be most cautious in not recommending any practice that has not been tried and proven for extended periods of time.

It is the duty of the Lubrication Engineer to have rather complete knowledge of the product being manufactured and the effect a lubricant may have on it.

When hypoid gears were first brought into general use, extreme pressure lubricants were called for. These lubricants contain chemicals that are highly reactive with photographic material. An analysis was made of the conditions of service in trucks and gear boxes used in the photographic industry. This analysis along with a knowledge of the effect of the different types of lubricants enables the photographic industry to violate the gear and oil companies' recommendations and still satisfactorily operate hypoid gears.

III. Writing of Lubricant Specifications

In a lubrication program, it is necessary for the engineer in charge to specify a complete range of lubricants to meet the variety of operating conditions in any particular plant. Great care should be exercised in writing the specifications for the desired lubricant so that entire groups of products will not be rejected because of the source of the crude, method of refining, or other unfounded reason.

Once a set of specifications is written, it should be continually examined to see if it is broad enough to take advantage of the technological improvements that are made in the petroleum industry and to meet the ever changing equipment and operating practices.

At the present time, stress is laid upon the initial physical characteristics such as viscosity, viscosity index, flash and fire points, neutralization number, etc. It is most useful for the Lubrication Engineer to think not only of the initial characteristics, but of the changes that take place when these lubricants are put into service. As an example, the change in the neutralization number of a turbine oil after it has been put into service is of real interest, while the same factor matters little in a squirt can oil since 90% of it is on the floor five minutes after it has left the can. As an aid to the persons using the specifications, the Lubrication Engineer should give a representative list of equipment and conditions where the lubrication is to be used.

IV. Testing and Evaluation of Lubricants

In the scope of Industrial Lubrication Engineering, the Engineer is charged with the responsibility of testing lubricants and of the vastly more difficult job of interpreting and evaluating the test results.

The testing can be divided into three divisions:

1. The selection of lubricants.
2. Quality control over incoming lubricants.
3. Control over the major lubrication systems while in operation.

At the present time we will consider only the first of these as the latter two will be discussed later in the paper.

Because lubricants vary in their characteristics it is necessary to measure as many of the important characteristics as possible before a lubricant is placed in service. It takes years to determine a good lubricant in service and an incorrect lubricant can ruin expensive equipment in short order. The American Society of Testing Materials has developed, and is continually adding, tests for the chemical and physical characteristics of lubricants, to guide producers and users in the selection of lubricants which should be satisfactory for service. Unfortunately there is insufficient knowledge of the chemistry of petroleum products, and unanticipated changes in the use of lubricants alter service conditions, so that standardized and accepted tests do not always guarantee service performance. The time lag between the recognition for the need of a test and the development and acceptance of a test is necessarily long. Therefore, the Lubrication Engineer must anticipate needed controls and develop his own where accepted tests are not available, or use those which appear to have merit long before they receive universal acceptance. This work must be approached cautiously and followed through to see that service performance follows the test predictions. The work must not be neglected through fear of the untried or unaccepted tests. There are many interests among petroleum producers, equipment builders and users, all of which must be satisfied before a test gains universal acceptance.

The evaluation of a lubricant by tests is so important that it warrants several examples. A large number of air conditioning units use an oil bath as a filter medium. Many of these units are serviced with highly refined oil. For experimental purposes a few of the units were serviced with a low-priced 100 sec. paraffin oil. Samples gathered from the units showed that the paraffin oil, in comparison with the highly refined oil, turned black, had a very bad odor, and had a rapid increase in neutralization number. All tests pointed to the fact that the paraffin oil was much too unstable for the job. Analysis of air samples on the discharge side of the conditioning units showed a very interesting condition. The unstable paraffin oil in comparison with highly refined oil had removed three times the volume of objectionable gases. Because this oil can remove a larger volume of gas from the air it is much the better product for that particular job, even though it does have a more rapid breakdown rate.

A few years ago oxidation inhibited oils were offered for sale. A preliminary examination of these oils showed them to have real promise, for extended use, but many questions as to film strength, wetting ability and corrosion and oxidation stability were left unanswered. By no standard accepted test could these characteristics be measured.

A test was developed (1) which measured all of these characteristics but film strength and its reliability has been proven in the field over the past seven years. Full advantage of the inhibited oils was taken for direct connected turbines, non-solvent refined oils for gear head turbines to prevent gear wear and finally the inhibited oils for gear head turbines when the film strength had been improved. All of this was done well in advance of any standard accepted tests or operating procedures. By doing this, from five to seven years, operating experience and use of the better lubricants was gained.

V.(a) Relationship With Purchasing Department

The purchasing of lubricants from a specific oil company is not a function of the Lubrication Engineer. The questions of price, financial responsibility, delivery, etc., are functions which rightfully belong to the Purchasing Department.

As was pointed out earlier, the Lubrication Engineer should determine the need for a minimum number of lubricants and then write specifications to cover the list of desired oils and greases. For each specification lubricant, the Purchasing Department should be furnished with several approved brands. Before approval all of these lubricants should be tested in the laboratory, and then used in limited service for a year or more before being placed on the approved list. With the exception of a few specialties the Purchasing Department should buy all of the plant lubricants from the approved list.

In judging any product, performance under the existing conditions of operations, and not price, is the determining factor. Many plants operate a large fleet of trucks for hauling products between buildings and carrying out various services required to keep the plant in production. Most of the gasoline is consumed in idling or very slow speeds. With gasoline of high boiling range the idling speed of trucks will be 300 to 400 R.P.M. With low boiling range gasoline the idling speed will be 200 to 300 R.P.M. Thus if low boiling gasolines are quoted at ¼ to ½ cents more per gallon, the lubrication engineer should advise their purchase, since for these operating conditions, the final cost would be lower.

The Lubrication Engineer can offer valuable assistance in the purchasing of equipment. Inasmuch as he does not specify, purchase, install, operate, or maintain equipment, he is in an unbiased position to observe and report the overall performance of equipment throughout the plant, and to investigate and report any unusual machine failures, placing the responsibility where it rightly belongs.

New equipment being purchased should be reviewed by the Lubrication Engineer, and checked for proper oiling systems, lubrication devices, and to make sure that gears, bearings, and materials of construction are of a type that will insure low operating cost. As a practical example several dry cleaning machines were purchased. The specific use required heating a solvent to 300°F. for an extended length of time, thus heating up the cleaning drum. Requesting the vendor to replace one of the main ball bearings with a roller bearing, allowed for machine expansion and still securely anchored the cleaning drum. From past experience the savings in labor and down time due to bearing failure from pinching was a real factor.

In order to provide lubrication consideration when purchasing new equipment, a special purchase specification covering the minimum lubrication requirements should be issued with the purchase order. One of the valuable results of this specification is to prevent the

purchase of equipment requiring a special lubricant or non-standard lubricating devices.

V.(b) Relationship With Stores Department

It is within the scope of Lubrication Engineering to determine the quantity of each lubricant needed for any specified length of time, and furnish to the Stores Department maximum and minimum inventory requirements.

The Stores Department should obtain for analysis a sample from each single drum shipment and a composite sample from several drums having the same lot number, when a larger shipment is received. The Stores Department should hold the lubricant until tests have shown it to be satisfactory to release for service.

Each sample sent in from the Stores Department need not be given a complete test for all physical and chemical characteristics, but should be given the minimum testing to assure that no mistake has been made in the type of oil received. The Lubrication Engineer should review the test results and make sure that the lubricant is within the purchase specifications. All responsibility for acceptance or rejection should rest with the Lubrication Engineer.

Thus, from the time of its selection for testing to the final acceptance of the delivered product the control of each lubricant is vested in the Lubrication Engineer. This centralization of responsibility avoids confusion with the vendors and insures our own operating and maintenance divisions that they will receive lubricants of uniform tested characteristics.

V.(c) Relationship With Mechanical Design Division

Mechanical Design offers an unlimited field for the Lubrication Engineer. Not only lubricants, but lubrication devices, centralized lubrication systems, bushings, bearings, gears, and materials of construction are well within the scope of his work. In some cases complete theoretical analysis of different bearing and gear and hydraulic layouts are furnished to the design engineer, along with supporting data justifying the course of action.

Specifications should be developed for each standard lubricant, giving the chemical and physical properties, as well as numerous general examples of use. These specifications will provide a valuable guide to the design engineer and will, at the same time, make him conscious of lubrication problems. Unusual problems should be referred to the Lubrication Engineer for solution. With the ever increasing diversity of industrial operations, the unusual lubrication problems seem to have no limit and provide the stimulus for research and development.

To provide for interchangeability, standardization of the methods of lubrication, and stocking of devices, the Lubrication Engineer should issue lubrication device standards to the Mechanical Design Division. These standards should include the general scope of lubricant application, the devices' characteristics, dimensions, thread sizes, and other pertinent information. In the selection of automatic devices, the mechanical features should be closely studied for dependability, as their failure to function will cause serious trouble.

Design of equipment should be analyzed to make sure that bearing and gear load will not be exceeded when the machine is put into operation. Stresses and overloading caused by expansion should be watched for. The Lubrication Engineer has a definite responsibility in checking design for future ease of maintenance. Equipment should be so constructed that with a minimum of effort it can be repaired. Oil leakage should be watched for. The design should be checked to make sure that gears are enclosed, bearings properly sealed, and a minimum amount of hand oiling required.

In many industries, equipment is manufactured that must be lubricated before it leaves the plant. The Lubrication Engineer should study the equipment and its intended use, and the probable operating conditions. His department should make general recommendations as to the proper lubricants and methods of application.

V.(d) Relationship With The Maintenance Division

Working with the Maintenance Division, the Lubrication Engineer has, perhaps, the best opportunity to apply in a practical way a knowledge of lubricants and put into effect a preventive maintenance program. The application of the lubrication program determines its worth.

Lubrication surveys are a very practical means of getting lubrication programs into operation, or to keep existing ones up to date. As new equipment is installed, operating conditions changed and the characteristics of lubricants improved, the survey should be checked for its validity. The success of the survey depends on the ability of the Lubrication Engineer to understand machinery, plant operating problems, and from experience supply a minimum number of products capable of filling the recommendations of the survey. The correct lubricant and its proper application will decrease the frequency of application, the amount used, and minimize the amount of product contamination by oil or metal dust. During the course of the survey the Lubrication Engineer should study and examine the machinery, look for inherently poor operating conditions and equipment construction, and plan practical means for correcting these conditions. No matter how good a lubricant and its method of application may be, it is not the cure for inherently poor conditions.

Once the survey has been made, and schedules drawn up, it is necessary to follow through to see that personnel is instructed and available for putting it into effect.

It should be pointed out that the complete survey is needed and useful for occasional reference, but the operating survey should be just as short and concise as possible. Far too many surveys become cumbersome and unworkable when taken into the field. Oilers should be carefully selected and have a favorable wage structure. Every effort should be made to educate the oiler in the basic fundamentals of his job, and to his importance in the program of preventive maintenance. In many instances he is the only man to inspect every piece of equipment within a reasonable period of time, and on him depends much of the information as to its condition.

In the major lubrication systems samples should be collected at specific intervals. Test results should be recorded along with other pertinent information such as amount of make up, operating temperatures, hours, etc. The interpretation of this performance history will enable the Lubrication Engineer to better judge the difference between the lubricants and advise oil changes and cleaning of tanks and filters before the system is "sludged" and a major disassembly and cleaning job called for.

It is well within the scope of Industrial Lubrication Engineering to look for better ways to do maintenance work and to see that they are given a reasonable and fair trial. Unusual or repeating mechanical breakdowns should be investigated and every effort made to control conditions so that they will not happen again.

Oil reclaiming offers a fertile field for the Lubrication Engineer. This can range from individual machine filtration to elaborate systems for plant wide collection and reclamation using stills, sulphuric acid, fullers earth and blotter presses.

With the increasing use of additives, the reclaiming program must be approached with caution. As example, some types of filter mediums are excellent for straight oils, while the same material will remove the detergent from a heavy duty engine oil.

Cutting oils, grinding compounds, quenching oils, and rust preventives are entire subjects within themselves, and will only be mentioned as part of the work of Industrial Lubrication Engineers.

V.(e) Relationship With Power Department

The production of steam, generation of power, supplying of refrigeration, compressed air and vacuum and the pumping, purification, and distribution of water are highly specialized fields of engineering yet the Lubrication Engineer must have enough facts concerning their peculiar operating conditions to intelligently advise, set up, standardize and direct their lubrication practices. Much of this equipment has oil systems of sufficient size to justify adequate filters, centrifuges, and coolers. Extremes in temperatures are often met, with a low of -60°F. on low temperature refrigeration to extremes of 350°F. to 400°F. on boiler valves and controls.

Greatly increased efficiencies, less down time and real savings can be affected by intelligent selection of lubricants. As an example, the use of a good inhibited oil will permit the overall turbine oil temperature to be raised 20° to 30°F., an annual savings of thousands of gallons of cooling water.

This phase of our work is a science within itself, and an entire series of papers should be prepared on the standard practices and problems of "Power and Refrigeration Lubrication."

V.(f) Yard and Service Department

The servicing of equipment such as a plant railway, Diesel and gasoline engines, and an entire truck fleet is important and should not be left to the trial and error methods of most any mechanic. Upon this service equipment depends the operation of the plant and it warrants the fullest attention of the Lubrication Engineer.

Additive type oils and the high compression engines have set the stage for an entirely new concept of service and maintenance for the internal combustion engine. The Lubrication Engineer will have an ever increasing part to play in its development, and in giving it guidance and direction.

V.(g) Accounting Department

To a large extent, Lubrication Engineering is a service. All of us in service positions have many times asked ourselves just how effective are we, and of what value is our work. We do not have a given number of pieces to produce per hour, and in many instances it takes from three to five years to evaluate changes which are recommended.

No lubrication and preventive maintenance program can be measured by dollar savings in the purchasing of lubricants. In fact, the "first cost" might be higher in a well-planned program. Neither is the total volume of oil used a yard stick to measure the need for lubrication works. Not long ago a well-known company tried to secure the services of a trained Lubrication Engineer. The Engineer refused the position because the total volume of lubricants purchased amounted to only $6,000 per year. He overlooked the fact that the total maintenance budget was about $750,000 per year, and product lost by oil contamination amounted to $150,000 per year.

The Accounting Department can help us measure the worth of our services. Figures can be supplied which will give us the overall maintenance cost per horse power delivered. Product rejects because of lubricant contamination, operating hours per bearing based on units of products, maintenance and fuel cost per ton-mile of hauling, and pieces of product per tool change, are but a few of the controls that will enable us to measure the value of our work over an extended period of time.

It is important that these figures be kept, as in the profit and loss system in which we work a large part of the industrial worth of any man is his ability to spend money wisely so that the final picture will be money saved.

VI. Unusual Methods For Solving Plant Problems

There are many maintenance and operating conditions which should be improved. The solution of these problems are held up because we lack the specific knowledge or the correlation of known facts.

Once a lubrication program has been established the Engineer in charge should objectively study some of these problems, and decide which ones he can solve. Many times the solution of these problems takes advantage of his highly specialized knowledge and requires little in the way of capital investments.

An example of this type of work is a bearing cleaning program. A large machine had over a hundred double-row roller bearings, lubricated from a centralized oiling system. The operating temperatures were high and over a period of years carbon and binders built up around the roll retainers until it was observed that a steam failure would cause the machine to cool, the deposits to harden, and the machine would refuse to start.

Working with an oil company a high flash, chloride and sulphur free solvent was developed. The solvent would dissolve the binders and free the carbon. With no damage to the system, the carbon would be carried away by the washing action of the solvent and flushing oil.

The solvent was circulated for three days and about 400 lbs. of oxidized oil and carbon deposits were washed from the system. The savings in labor over manual cleaning was about $10,000, the down time was reduced from 30 to 3 days, with no damaged parts or reassembly job to do.

VII. Relationship With Salesmen and Technical Representatives of Vendors

Lubricant and lubrication device salesmen will welcome the centralization of the plant lubrication service. All parties concerned will save a tremendous amount of time, as most technical problems can be cleared between two persons. The knowledge gained from the overall plant requirement enables the Lubrication Engineer to present a clear picture to the vendor as well as enabling him to obtain consideration of all plant requirements in one interview.

A great deal of the mystery and "high pressure" tactics will give way to facts and a scientific consideration of the problems at hand. Thus the salesman with a clean-cut proposition will gain the fullest consideration, based on the merits of his product and service.

The Lubrication Engineer through continuous contacts with the various vendors' salesmen is in a position to know what matters should be taken up with the local representatives and which matters require the advice of more specialized personnel such as research and design divisions.

It is this close cooperation between lubricant manufacturer and user that will solve many of our minor problems and so govern matters that the seriousness of the larger problems will be eliminated and reduced to a marked degree, with real savings in production and maintenance costs, irrespective of the initial costs of the lubricants.

Acknowledgment

The author wishes to acknowledge invaluable assistance of Mr. C. L. Pope, Lubrication Engineer for the Eastman Kodak Company in preparation of this paper, and Mr. M. D. Lee, Asst. Supt. of Industrial Engineering, Mr. R. A. Hall and Mr. C. A. Elwood for their careful review and comments.

References

C. L. Pope—D. A. Hall.
"Oxidation-Corrosion of Lubricating Oils," A. S. T. M. Bulletin No. 121, Page 25, March, 1943.
A. S. T. M. "Proceedings of the 46th Annual Meeting." Vol. 43, 1943, Pages 275-278.

VIII. Outside Organization Work

As Lubrication Engineers within our own industry we will continue to do, to the best of our ability, our own particular job as we see it. In doing this we go to the required mile, but beyond that lies the second mile; the voluntary mile that transforms an ordinary job into a profession.

What is the best procedure for doing this voluntary work? None can neglect study. By reading of the experiences of others we save ourselves many hours of pioneering work, and gain a broader understanding of the principals of our problems. Yet reading alone is not the ultimate answer. Beyond the realm of recorded experiences lies a vast field of untested exploratory knowledge that should be examined, expanded, and classified. Through organization work and meetings of common interest the Lubrication Engineer has at his command one of the better means of constructive analysis of untried ideas. Individual ideas can be examined in the light of other people's experience, and proposals of sufficient common interest can be worked on by a group of engineers.

As Lubrication Engineers we can promote within the universities a program of education and research so that our ranks will be filled with men well-versed in the fundamentals of the profession.

We should cooperate with other societies in the development and exchange of knowledge. The A.S.T.M., A.P.I., S.A.E., A.Ch.S., and A.S.M.E. have and will continue to contribute much to our profession. Our problems and aims are closely allied and in working together we will find the answers to some of them.

This is a most ambitious program, but one that must be carried through if we are to keep abreast of the advancement in the technical and industrial sciences.

Conclusion

The Scope of Lubrication Engineering in Industry is a very broad subject. An attempt has been made to briefly outline a few of the fields of endeavor and problems confronting the average Lubrication Engineer. This is merely a beginning. Perhaps many of the activities mentioned rightly belong outside of the lubrication field and others, not mentioned, should be incorporated in the department.

The main purpose and objective of this paper is to stimulate thinking in the field of lubrication and preventive maintenance and to focus the attention of both engineers and management on them. Far too many times a lubrication program is judged by the volume of lubricants used and their initial cost. The true value of the lubrication program is measured by greater operating efficiencies coupled with lower maintenance costs.

Announcement has recently been made of a new abstract digest entitled "Petroleum Research Abstracts on Fuels and Lubricants." This project is being run by Mr. A. E. Hickel, 30 West Washington Street, Chicago, Illinois, and should be of interest to members of the research group.

American Society of Lubrication Engineers —History

By B. H. JENNINGS*

The American Society of Lubrication Engineers owes its inception largely to the perseverance and farsightedness of one man, Walter D. Hodson.

In the latter part of 1942 the late Phillip G. Waterman, working with Walter D. Hodson, Douglas Evans, Charles Bailey and W. R. Jenkins, prepared the groundwork of the Society. A committee from this group, carrying through plans which they had discussed, prepared a report and a draft of by-laws for this Society on February 15, 1943.

Led by Mr. Hodson, a working committee was set up early in 1944 and a petition for articles of incorporation of the American Society of Lubrication Engineers was filed in Illinois on March 3, 1944. Following this, and carefully checking all legal aspects, a petition for articles of incorporation was drawn up by Peter Newton Todhunter and named in the articles of incorporation as directors were Walter D. Hodson, Peter Newton Todhunter, Roy A. Watkins, Hugh B. Conover and Warren G. Bailey.

The first formal meeting of this Board of Directors was held in Chicago the 10th day of March, 1944. The by-laws, which had been previously drawn up, were presented to the Board of Directors and approved. The Board of Directors then tendered its resignation, to take effect as soon as a new group of Officers and Directors could be appointed. For this purpose, and because it was realized that the only successful organization would be one which had national scope to serve the best interests and needs of the industry, a national organizational meeting was called for Wednesday, September 27, 1944. Under the guidance of Mr. Hodson, a group of some 100 people assembled for a dinner meeting in the ballroom of the Pittsburgh Athletic Association, Pittsburgh, Pennsylvania. Following dinner, Mr. Hodson called the meeting to order and recalled some of the historical background leading up to this meeting.

WALTER D. HODSON

The group of interested men who had assembled presented a cross-section of nearly all types of industry and many of the individuals had come great distances. Steel company interests, lubricant producers, equipment manufacturers, chemical industries, railroads, educational institutions, and research groups were represented by those in attendance. Telegrams and letters of regret had been received from many others who could not attend because of the press of war activities, but most of these indicated their interest in an organization to foster the dissemination of lubrication knowledge and to encourage research and the exchange of ideas for the mutual betterment of all concerned with the use or production of lubricants.

Mr. Hodson, after presenting his report, asked Mr. O. L. Maag to take over the Chairmanship of the meeting for the purpose of appointing a Nominating Committee to select candidates for office in the Society. The Nominating Committee presented: for Directors, D. E. Whitehead of the Carnegie-Illinois Steel Corporation, D. N. Evans of the Inland Steel Company and I. L. Harper of the Lehigh Valley Railroad; C. E. Pritchard of the Republic Steel Company for President, J. C. Peebles of the Illinois Institute of Technology for Vice President, and B. H. Jennings of the Technological Institute of Northwestern University for Secretary-Treasurer. It was moved and seconded that the report of the Nominating Committee be accepted and the slate of officers presented was elected unanimously by all of those in attendance. Mr. Maag then asked President Pritchard to take the chair.

The remainder of the meeting, under the Chairmanship of President Pritchard, was concerned with a discussion of problems of the Society, the appointment of Committees and plans for the future. It was moved, seconded and passed that the by-laws which had been drawn up be formally accepted as the guiding rules of the Society.

The first meeting of the Directors and Officers of the Society was held November 1, 1944, at the Union League Club in Chicago. Additional Committees were appointed and the various classes of membership outlined and decided upon.

(Continued on page 32)

* *Secretary-Treasurer of the A.S.L.E.*

NATIONAL OFFICERS

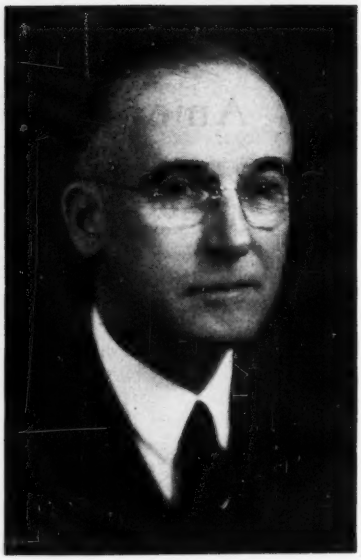
American Society of Lubrication Engineers

C. E. PRITCHARD

Mr. C. E. Pritchard, Pesident of the American Society of Lubrication Engineers, graduated in Mechanical Engineering at the Carnegie Institute of Technology in 1932. Upon his graduation he joined the Lubrication Department of the Atlantic Refining Company and left in August, 1937, to become millwright at the Warren District of the Republic Steel Corporation (Strip Mill Department). Here he rebuilt and managed the installation and maintenance of mill machinery. In July, 1938, he assumed the duties of Lubrication Engineer for the Warren District, which comprised the Warren Plant, Niles Plant, Trumbull-Cliff Furnaces and Newton Falls Plant.

He became Chief Lubrication Engineer of all Republic Steel Corporation operations, including all steel plants, manufacturing divisions and mines, in March, 1941.

Mr. Pritchard has been active in society and committee work, including membership on the Slushing Oil Committee of the A.I.S.E., from 1941 to the present date, the Program Committee (lubrication sections) and on the Membership Committee of the A.I.S.E.



J. C. PEEBLES

Mr. J. C. Peebles, Vice President of the American Society of Lubrication Engineers, was born in Scotland in 1880, and, at an early age, came to America where he went to live in Iowa.

He attended grammar school and high school in Shenandoah, Iowa, and came to Chicago in 1900, at which time he enrolled in the Lewis Institute. He received the degree of Bachelor of Science in Electrical Engineering in June, 1904, from the Armour Institute of Technology.

Mr. Peebles was an instructor and graduate student at Cornell University from 1904-1908, and received the degree of Master of Mechanical Engineering from Cornell University in June, 1908, and, in the same year, received the professional degree of Electrical Engineer from the Armour Institute of Technology.

Since 1908, he has been an instructor, assistant professor, associate professor and professor of Experimental Engineering at the Armour Institute of Technology, and was the acting head of the Department of Mechanical Engineering, 1939-40. In 1941, he was made Dean of Engineering at the Illinois Institute of Technology, which position he is holding at the present time.

B. H. JENNINGS

Mr. B. H. Jennings, Secretary-Treasurer of the American Society of Lubrication Engineers, was born in Baltimore, Maryland in 1903, and obtained his early engineering education at the Johns Hopkins University. He did his graduate work at Lehigh University, receiving the M.S. degree in 1928.

He was a member of the teaching staff at Lehigh University from 1926 to 1940, leaving Lehigh University to become Professor of Mechanical Engineering and Chairman of the Department at the Technological Institute of Northwestern University in 1940.

In addition to his work in education, Professor Jennings has been an active engineering consultant and has directed a large amount of research work. In particular, during the war, Mr. Jennings has been active in the conduct of a confidential research project for the Office of Scientific Research and Development.

More than a score of technical papers are credited to his name, and he is the author or co-author of four books.

Active in Society work, he is a member of the A.S.M.E., A.S.H.V.E. and A.S.R.E. In the latter of these Societies he has just completed his tenure as Chairman of the Chicago Section.

D. E. WHITEHEAD

Mr. D. E. Whitehead, a Director of the American Society of Lubrication Engineers, was born November 3, 1905, near Pittsburgh, Pennsylvania. He obtained his engineering education at the Carnegie Institute of Technology and participated in the Lubri-Zol Cooperative Lubricants Research Program conducted at the Case School of Applied Science. For 13 years he was in lubrication engineering sales and for three years Lubrication Engineer of the Homestead Steel Works, finally taking his present position of Lubrication Engineer for the Carnegie-Illinois Steel Corporation.

D. N. EVANS

Mr. D. N. Evans, a Director of the American Society of Lubrication Engineers, was born August 11, 1910. He attended Marquette University, Clemson College, the University of Wisconsin, and in 1935 received a B.S.M.E. degree at the University of Oklahoma.

Mr. Evans started work with the Inland Steel Company in the Mechanical Department of the 40″ Blooming Mill in 1935. For three years he was machine shop foreman and then took over duties as Lubrication Engineer in 1939. Mr. Evans is also a member of the Association of Iron and Steel Engineers.

I. L. HARPER

Mr. I. L. Harper, originally elected a Director of the Society, was compelled to resign, as the press of his wartime duties with the Lehigh Valley Railroad made it impossible for him to attend the Board meetings.

NEWS of the

Cleveland-Youngstown Section

R. J. HAGAN
Vice-Chairman
Cevelend-Youngstown Section

The Cleveland-Youngstown Section held an organizational dinner meeting at the Hotel Carter in Cleveland on March 27th. The presiding officers were Mr. C. A. Bierlein, Chairman Pro-Tempore, and Mr. F. D. Johnson, Secretary, Pro-Tempore.

Eighty-six persons including representatives from Akron, Canton, Warren, Youngstown, Toledo and Lorain in addition to Cleveland attended the meeting.

A petition for Charter in the National Society was signed by those present and forwarded to National Headquarters at Chicago for acceptance.

Mr. C. E. Pritchard then spoke and outlined the aims and purposes of the Society.

Open discussion regarding subjects to be considered for subsequent meetings occupied the rest of the meeting. Seventeen topics in all were suggested from the floor.

The following officers were elected:

Chairman—C. A. Bierlein, Cleveland Diesel Division of General Motors Corp., Cleveland.

Vice Chairman — R. J. Hagan, Republic Steel Corp., Youngstown.

Secretary-Treasurer—L. W. Fitch, The Dingle-Clark Co., Cleveland.

On May 7th the first papers meeting of the Cleveland-Youngstown Section was held. This convened at the Cleveland Club and Dr. R. G. Larsen of the Shell Oil Development Company, Emeryville, California, spoke on the subject "Testing Lubricants with the 4 Ball Type Machine." Dr. Larsen discussed the various types of 4 Ball machines telling how each is used and giving the results which could be obtained using such equipment. A number of slides were shown by Dr. Talley to supplement Dr. Larsen's talk. A very active and spirited discussion period followed the paper.

Various committee appointments were announced following the meeting. The Program and Planning Committee is under the Chairmanship of J. A. Finkel-

L. W. FITCH
Secretary-Treasurer
Cleveland-Youngstown Section

man of the Warren Refining and Chemical Company; the Membership Committee under the Chairmanship of J. W. Kasmark of the Parker Appliance Company; the Nominations Committee under the Chairmanship of J. D. Johnson of the Trabon Engineering Corporation.

Milwaukee Section

The Milwaukee Chapter of the American Society of Lubrication Engineers owes its origin to the interest and enthusiasm of Mr. George Radosevich, Lubrication Engineer of the Harnischfeger Corporation.

Early in January of this year, Mr. E. J. Ehret of the Chicago Section had been in contact with Mr. Radosevich and had told him of the formation of the National Organization, the Chicago Section, and of the plans for the National Convention to be held in Chicago in February.

Visualizing the needs and advantages of an organization of this type in the Milwaukee area, Mr. Radosevich contacted several of his associates and arrangements were made to attend the Chicago meeting and to meet the National Officers in order to obtain information on the necessary procedure for the formation of a local section. Five men from Milwaukee attended the Chicago meeting and came back very much impressed with the caliber of the organization, its possibilities and the real need of this organization in the lubrication profession.

On February 14th, Messrs. G. Radosevich, W. H. Krause, C. J. Beck, C. G. Peterson and W. A. Alexandroff, met and elected G. Radosevich, Chairman Pro-Tem, and W. A. Alexandroff, Secretary-Treasurer Pro-Tem. A petition for a charter was drawn up and plans formulated for the organizing of the Chapter.

Pittsburgh Section

The first meeting of the Pittsburgh Section of the American Society of Lubrication Engineers was held January 31, 1945, at the University Club in Pittsburgh and was attended by approximately seventy. Dinner was served, after which temporary officers were elected and an organization established.

On March 7th, the second meeting of the Section was held at the College Club in Pittsburgh. Dr. L. J. Berberich of Westinghouse Research Laboratories read a paper on "Oxidation Inhibition In Insulating Oils" which paper was well received. The reading was followed by a very interesting discussion.

The third meeting of the Pittsburgh Section was held on April 20th at the University Club in Pittsburgh. The following officers and committee chairmen were elected:

Chairman—B. J. Lamport, United Engineering and Foundry Company.

Vice Chairman—E. B. Svenson, Jr., National Tube Company.

Secretary — Wilbur Deutsch, Trabon Engineering Corporation.

Treasurer—Dr. O. L. Brandes, Gulf Research and Development Company.

Program Committee: Chairman, E. B. Svenson, Sr., Aluminum Company of America.

Membership Committee: Chairman—L. J. Gray, Dingle Clark Company.

Entertainment Committee: Chairman — S. M. Fink, Alemite Company of Pittsburgh.

Following the election of officers, it was decided to hold the monthly meetings on a Friday night, late in each month. A number of suggested subjects were given Mr. E. B. Svenson, Sr., Chairman of the Program Committee, for prospective papers.

The Pittsburgh Section formally requested a charter on January 31, 1945, and this was granted by President Pritchard on February 5, 1945.

SECTIONS

A charter was granted on March 1, 1945, and Milwaukee became Chapter No. 3 of the American Society of Lubrication Engineers.

On the 14th of March a meeting was called of all members and a group of interested persons. Fourteen were present. Applications for membership were accepted and this group agreed to act as the organizing committee. Plans were laid for an open meeting, publicity and membership.

On the 27th of March a meeting was called and officers for the ensuing year were elected and committees appointed as follows:

Chairman — W. H. Krause, Organic Chemist, Allis Chalmers Manufacturing Company.

Vice Chairman — O. Frohman, Consulting Engineer, Ampco Metal, Inc.

Treasurer—R. E. Schultz, Technical Manager, Socony Vacuum Oil Company, Wadhams Division.

Secretary—W. A. Alexandroff, Technical Advisor, Pate Oil Company.

Program Committee — C. J. Beck, Chairman, Lubrication Engineer, Globe Steel Tubes Company—T. Wegman, Lubrication Engineer, A. O. Smith Company—D. W. Johnson, Manager Industrial Division, Standard Oil Company of Indiana.

Membership Committee—G. M. Lunz, Chairman, Lubrication Engineer Lincoln Engineering Company.

The first meeting of this Chapter was held in the Crystal Ballroom of the Schroeder Hotel in Milwaukee, Wisconsin, on May 21st, 1945. At a dinner meeting preceding the regular meeting, the Chapter officers and members met with President Pritchard for an informal get-together and discussion of Society affairs.

Over 100 men from representative Wisconsin industrial plants were present. President Krause opened the meeting by introducing National President Chas. E. Pritchard, who in a very able manner outlined the origin and aims of this Society. He stressed the need for better understanding and appreciation of lubrication. The benefits to be gained by fostering education and disseminating information such as this Society can provide will, without considering any of the many other obvious benefits, be sufficient justification for existence of this Society.

Our secretary, Mr. Walter Alexandroff, presented a resumé concerning the formation of the Milwaukee Chapter.

President Krause then introduced Mr. J. R. Sloan, Assistant Chief Metallurgist in charge of lubrication at the Caterpillar Tractor Company, Peoria, Illinois, who delivered the principal address of the evening. His talk clearly outlined the setup and functioning of lubrication at Caterpillar. He cited definite applications and case histories. He demonstrated the real benefit of an adequate Lubrication Department from a dollar and cents standpoint.

"Lubrication means a great deal more than just smearing grease on a gear or pouring oil," said Mr. Sloan. "The alert lubrication engineer must know functions, operations, materials, and design, so all related or affecting factors can be properly evaluated and correct lubrication standards provided." The lively discussion which followed left little doubt of the high interest in lubricating applications and the desire to learn more of the problems and results.

All in all, this first meeting of the Milwaukee Chapter indicated that it is off to a good start. It is planned to hold several informal meetings throughout the summer and resume regular technical meetings beginning next September.

D. FROHMAN, *V-Chairman.*

Chicago Section

The Chicago Section of the American Society of Lubrication Engineers requested a charter on January 3, 1945, and on January 22, 1945, its charter was granted.

The first meeting of the Section was held on February 9th at the Stevens Hotel. This meeting was purposely scheduled at this time so as to coincide with the period previously planned for the National Convention. The National Society postponed the National Convention in order to cooperate with the edict of the War Committee on Conventions which suggested that all conventions be discontinued during the War Emergency.

C. A. BAILEY
Chairman, Chicago Section

E. J. EHRET
Secretary-Treasurer, Chicago Section

Mr. Charles A. Bailey presided at the meeting as Pro Tempore Chairman, with Mr. D. N. Evans as Secretary-Treasurer. At the election which was conducted at the meeting, Mr. Charles A. Bailey, Chief Lubrication Engineer of Gary Works, Carnegie-Illinois Steel Corporation, was elected the first chairman, and Mr. E. J. Ehret, District Representative of the Farval Corporation, Chicago, was elected the first Secretary-Treasurer.

Two outstanding papers were presented at this meeting. Mr. Warren Bailey of McKinsey Kearney and Company spoke on "Lubrication from Management's Viewpoint" and Mr. N. C. Penfold of the Armour Research Foundation spoke on "Engine Lubrication Research." Mr. C. E. Pritchard, National President of the Society, was called upon and made some remarks concerning National Society affairs. The attendance at this first meeting was in excess of 130.

The second meeting of the Chicago Section was held April 6th at Hyler's Restaurant with an attendance of 103. At this meeting Mr. D. B. Burt of the Lincoln Engineering Company spoke on "Powerized Lubricating Equipment." In addition, the Texas Company presented a technicolor sound picture entitled "Deep Horizons." Mr. Bailey presided and announced working committees of which the chairmen are:

Entertainment Committee: John R. LeVally—Lincoln Engineering Company.

Membership Committee: Clarence Weidling — Socony-Vacuum Oil Company.

Standards Committee: George Bowers —Standard Oil Company of Indiana.

History of the A. S. L. E.

(Continued from page 27)

The grades consist of Member, Associate Member, Junior Member and Sustaining Members. The latter consist of institutional or company members interested in supporting and carrying on the activities of the Society. Details on the classes of membership are listed elsewhere in this issue. The time of holding the first Convention was set for the period February 8 and 9, 1945, and this was planned for Chicago.

Additional meetings were held November 27, 1944 and January 10, 1945, and finally, on January 23, 1945, an emergency meeting was held to consider the plan of action to be taken following the edict of the Office of Defense Transportation which refused permission for any Society to hold a Convention after February 1, 1945, because of the emergency which had developed in the national transportation and housing situation. In order to cooperate fully with the War Effort, the Society willingly agreed to postpone the Convention and to stress the importance of Local Section meetings.

The first of these meetings was held February 9, 1945, by the Chicago Section, and since that time meetings have been held by other Sections throughout the country. At the time of writing this brief history of the Society, active sections exist in Chicago, Pittsburgh, Milwaukee and Cleveland-Youngstown. Additional sections are in process of formation in other cities.

The growth in membership of the Society has been rapid, and as of June 1, 1945, consists of 363 members with the number increasing daily as news of the Society spreads.

The support of industry through Sustaining Memberships in the Society has been extremely encouraging with 17 companies representing equipment manufacturers, steel companies, large oil producers, lubricant specialists, manufacturing and chemical companies so far having contributed. Each of the Sustaining-Membership companies appoints one of its members to represent its Sustaining Membership, and from this group one of the Directors each year will be selected for the Society.

The Nominating Committee of the Society will soon make its report of nominations for the three additional Directors who are to be appointed in 1945, and these men will be elected by letter ballot. Normally, the Directors would be elected at one of the Conventions, but under War conditions this is not possible.

The magazine of the Society is to be a quarterly journal, at least for the year 1945, and three additional issues are planned. The Society and Journal can best serve the interests of its members and of the lubrication industry by printing papers and disseminating pertinent news. The officers of the Society will welcome high grade papers and reports of events and happenings in the world of lubrication for inclusion in the Journal.

Evaluation of Crankcase Oils

(Continued from page 11)

10. The rate and amount of reaction of the test oil is determined by physical or chemical analysis from either periodic partial samples taken during the test or the final entire sample.

At the conclusion of the test, the oil and parts of the apparatus are inspected and analyzed for one or several of the previously mentioned deterioration characteristics. The analysis is made with physical or chemical tests or simply by visual observation. The listing in the appendix includes some tests made for characteristics other than oil deterioration. These are for specific properties such as foaming and emulsification. However, the procedure involved is often too arbitrary to be considered as a pure analytical laboratory method and may approach or exceed bench testing scope.

The analysis of bench test results must be considered advisedly. They do not as yet duplicate or completely correlate the laboratory or field engine results. In addition to supplementing engine data they furnish an expedient means of developing new lubricating oil base stocks and chemical oil additives.

Engine tests have been devised which furnish more pertinent crankcase oil evaluation data. These engine tests may be for so-called oil pre-evaluation and call for the operation of small-scale units or prototype units, or they may require full-scale engines in which case the evaluation data obtained may be directly interpreted and used for qualification or specification purposes. A wide variety of engines, both gasoline and Diesel, have been used and numerous operating procedures have been formulated in an effort to accentuate certain oil characteristics or to most closely simulate field operating conditions.

Field testing in commercial operations is the ultimate evaluation method. Obviously, the expense and scope of this procedure prohibits its extensive use. Field testing, although presenting the true commercial picture, does not always furnish accurate data for subsequent laboratory analysis since the usual precision laboratory control so necessary for research and development is usually lacking. To overcome this, field tests are often made with full scale vehicles, operated with full laboratory control under conditions simulating actual commercial applications.

This latter method practically eliminates the human element normally encountered in commercial operations and remains within the meaning of scientific approach. However, since the unscientific human element is present in practically all the ultimate applications of oil, one may recommend that this approach also be included in subsequent investigations. It appears at present that the best method is an educational program which gives the operator an appreciation for the correct use and limitations of lubricants.

NATIONAL COMMITTEES

of

THE AMERICAN SOCIETY OF LUBRICATION ENGINEERS

Nominating Committee:

D. F. HOLLINGSWORTH, Chairman
E. I. duPont deNemours and Company
1007 Market Street
Wilmington 98, Delaware
D. D. FULLER
H. C. KRAEMER

Program, Planning and Publications Committee:

E. M. KIPP, Chairman
Aluminum Company of America
New Kensington, Pa.
H. A. AMBROSE
D. F. HOLLINGSWORTH
R. G. LARSEN
N. C. PENFOLD
D. D. FULLER
W. S. MCKEE

Finance Committee:

D. N. EVANS, Chairman
Inland Steel Company
East Chicago, Indiana
B. H. JENNINGS, ex-officio

Membership Committee:

C. A. BAILEY, Chairman
Carnegie-Illinois Steel Corp.
Gary Works
Gary, Indiana

By-Laws Committee:

D. E. WHITEHEAD, Chairman
Carnegie Illinois Steel Corp.
Carnegie Building
Pittsburgh, Pa.

AMERICAN SOCIETY OF LUBRICATION ENGINEERS

Grades of Membership

Membership in the Society is in several grades as defined below. Assignment to grade is made by the Admissions Committee or Board of Directors on the basis of information submitted or supplied by references.

MEMBER

A member shall be not less than twenty-four (24) years of age. A member must have occupied a recognized position in the practice of lubrication engineering for a period of not less than three (3) years at some period prior to the date of admission, involving the responsibility for, or supervision of, the development, selection, field use and application of lubricants as differentiated from other activities, or he must have engaged in research or instruction at technical schools, universities, and various publicly and privately supported institutions, on the subject of lubrication.

$10.00

ASSOCIATE MEMBER

An associate member shall be not less than twenty-four (24 years of age. Associate members are persons who are indirectly concerned with the applications of lubrication but, qualified by experience, knowledge and accomplishment, have manifested a particular interest in the purpose and welfare of the Society to the extent that their membership would be a valuable contribution to the successful functioning of its activities. In general, executives not directly concerned with the use of lubricants or those whose major interest is in the field of lubricant manufacture, sales of lubricants, or promotional activity associated with lubricants will be classed as associate members.

$10.00

JUNIOR MEMBER

Junior members shall be persons of less than twenty-four (24) years of age, or those over twenty-four (24) years of age whose activities place them in the member group but whose background does not yet let them qualify under the three (3) year period of responsibility in the field of lubrication.

$5.00

SUSTAINING MEMBERS

Sustaining members are such persons or organizations as may be interested in and desire to contribute to supporting the purposes and activities of the Society. The fees paid by a sustaining member in general will not be allowed to exceed $200.00 per year.

The Pace of Victory Permits Only A Congratulatory Handshake!

American Industry well merits a decoration for its brilliant record in the Mighty 7th! But, as our newly decorated Pacific heroes quickly return to combat, so industrial leaders aren't resting on their laurels. ***Back into Bond action***—they are now busy consolidating recent Payroll Savings Plan gains!

First, many executives are now patriotically working to retain the substantial number of new names recently enrolled during the 7th War Loan. By selective resolicitation, they are urging all new subscribers to maintain Bond buying allotments.

Second, many are also employing selective resolicitation to urge every worker who increased his or her subscription in the 7th to continue on this wise, saving-more-for-the-future basis.

Help to curb inflationary pressures and harvest peacetime prosperity by holding the number of Payroll Savings Plan subscribers—and amounts of individual subscriptions—to the mark set in the Mighty 7th!

The Treasury Department acknowledges with appreciation the publication of this message by

LUBRICATION ENGINEERING

★ *This is an official U. S. Treasury advertisement—prepared under auspices of Treasury Department and War Advertising Council* ★